DISSERTATION

THE IMPACT OF CONSTRUCTIVIST TEACHING STRATEGIES ON THE ACQUISITION OF HIIGHER ORDER COGNITION AND LEARNING

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY ALISON S. MERRILL ENTITLED THE IMPACT OF CONSTRUCTIVIST TEACHING STRATEGIES ON THE ACQUISITION OF HIGHER ORDER COGNITION AND LEARNING BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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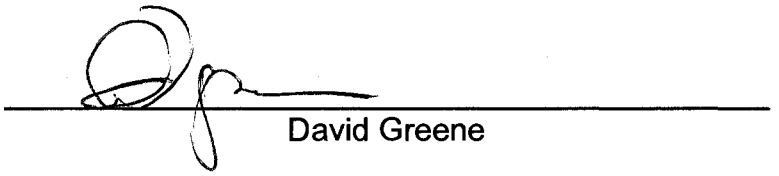

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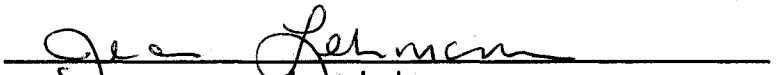

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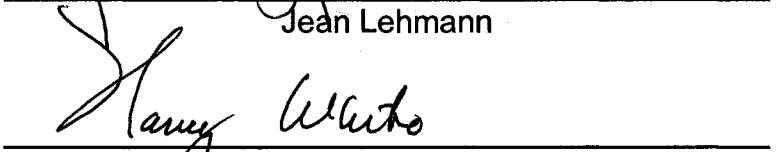

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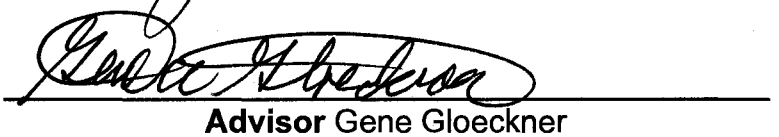

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ABSTRACT OF DISSERTATION

THE IMPACT OF CONSTRUCTIVIST TEACHING STRATEGIES ON THE ACQUISITION OF HIGHER ORDER COGNITION AND LEARNING

The purpose of this quasi-experimental quantitative mixed design study was to compare the effectiveness of brain-based teaching strategies versus a traditional lecture format in the acquisition of higher order cognition as determined by test scores. A second purpose was to elicit student feedback about the two teaching approaches. The design was a 2 x 2 x 2 factorial design study with repeated measures on the last factor. The independent variables were type of student, teaching method, and a within group change over time. Dependent variables were a between group comparison of pre-test, post-test gain scores and a within and between group comparison of course examination scores. A convenience sample of students enrolled in medical-surgical nursing was used. One group (n=36) was made up of traditional students and the other group (n=36) consisted of second-degree students.

Four learning units were included in this study. Pre- and post-tests were given on the first two units. Course examinations scores from all four units were compared. In one cohort two of the units were taught via lecture format and two using constructivist activities. These methods were reversed for the other cohort.

The conceptual basis for this study derives from neuroscience and cognitive psychology. Learning is defined as the growth of new dendrites. Cognitive psychologists view learning as a constructive activity in which new

knowledge is built on an internal foundation of existing knowledge. Constructivist teaching strategies are designed to stimulate the brain's natural learning ability.

There was a statistically significant difference based on type of teaching strategy (t = -2.078, df = 270, p = .039, d = .25) with higher mean scores on the examinations that used brain-based teaching. There was no statistical significance based on type of student. Qualitative data collection was conducted in an on-line forum at the end of the semester. Students had overall positive responses about the constructivist activities. Major themes were described.

Constructivist strategies help bridge the gap between neurological and cognitive sciences and classroom teaching and learning. A variety of implications for nursing educators are outlined as well as directions for future research.

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Rod Holland has been an unflinching support over the past five years. He has never complained about the amount of time I have spent in course work, research, and writing even though it definitely deprived us of time together. I am so lucky to have him by my side. I have many, many friends and colleagues who have continued to support my efforts with humor, positivity, and diversion activities. I am grateful to you all.

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CHAPTER ONE:

INTRODUCTION

"The mind is a fire to be kindled, not a vessel to be filled." Plutarch

Humans are biologically driven to make sense of their world (Caine & Caine, 1994; Smilkstein, 2003). How they are able to learn and adapt to ever changing internal and external environments is a question that has long intrigued researchers from a wide variety of fields. Researchers have historically struggled with the question of nature versus nurture: Does a person's genetic make-up pre-determine IQ and the ability to learn or is a person born with an endless number of possibilities that will come to fruition based on the environment?

To answer this question cognitive psychologists focus on the mental processes and knowledge structures that can be discerned from observable behaviors (Grippen & Peters, 1984; Wittrock, 1978). Cognitive psychologists who are interested in learning study the mental processes that occur as a result of interactions between a stimulus and a response. According to these theorists, the learner responds best to environmental stimuli that make sense according to pre-existing mental structures (Grippen & Peters). Cognitive psychologists developed the concept of learning as a constructive activity based on the work of Piaget (1975). Piaget held that assimilation, accommodation, and construction of knowledge in the developing child were the primary processes of learning. A learner constructs new knowledge by building on an internal foundation of existing knowledge through a personal interpretation of experience.

Cognitive neuroscientists are interested in how learning is reflected in neurochemical brain activity and structural adaptation. They approach this question by observing the brain's reaction to controlled stimuli. It is now possible through a variety of non-invasive brain scanning devices to visualize changes in different parts of the brain as it responds to a variety of stimuli and tasks (Gogtay et al., 2004; Zull, 2002). Positron Emission Tomography (PET) scans and functional Magnetic Resonance Imaging (fMRI) scans have enabled researchers to track activity in specific areas of the brain when a subject is asked to perform a variety of tasks, including recognition and memory formation (Donaldson, Petersen, Ollinger, & Buckner, 2001; McDermott, Jones, Petersen, Lageman, & Roediger, 2000; Shulman, Ollinger, Linenweber, Petersen, & Corbetta, 2001). These technological innovations have added to the body of knowledge about how people learn. The early work of Diamond (Diamond & Hopson, 1998) demonstrated that cerebral cortexes in rats actually grew when they lived in enriched environments that included opportunities for exploration and interactions with other rats. Draganski, et al. (2004) was able to demonstrate growth in the density of a portion of the motor cortex responsible for sensing movement in subjects who were taught to juggle. Learning, therefore, involves structural changes in the brain as well as changes in observable behaviors. As can be seen, research on learning in the burgeoning field of neurosciences supports many of the assumptions of earlier cognitive scientists. A gap still exists, however, in how to translate the findings from both fields into classroom practice.

One thing that is clear is that human beings are fantastic learners. They can master millions of details about language, objects, and human behavior, and they can understand patterns of relations among a myriad of incoming facts and experiences (Spence, 2001; Hart, 2002). The brain's ability to grow and adapt to new information mirrors the cognitive psychology view that knowledge is built or constructed from previous knowledge. Incorporating constructivist teaching strategies that enhance the brain's natural learning abilities has been studied in K – 12 classrooms (Brandt, 1998; Caine & Caine, 1995; Fogarty, 2002; Foster-Deffenbaugh, 1996). There is less research available on the use and effectiveness of constructivist teaching methods in higher education. Investigating the effectiveness of such strategies in a nursing classroom is the purpose of this study.

Problem Statement and Context

Nursing students are expected to master an enormous amount of theoretical knowledge and then immediately apply that knowledge in the care of acutely ill patients (Adams, Murdock, Valiga, McGinnis, & Wolfertz, 2002). It is therefore imperative that nursing education classrooms are structured and managed in ways that ensure a thorough acquisition and understanding of knowledge. In the health care arena, nurses work both collaboratively and independently. Their roles range from direct patient care to coordinating and directing complex patient care scenarios and systems. They must recognize not only urgent, actual patient problems; they must also be aware of and respond to

potential and co-morbid complications. In a health care facility a nurse serves as care giver, care coordinator, patient and family educator, patient advocate, and emotional support system to patients and their families. In the community, nurses serve in a wide variety of public venues such as public health departments, schools, businesses, and clinics. A new graduate nurse must be prepared to assume a full range of responsibilities within a few months of employment (American Association of Colleges of Nursing, 2004). It is imperative, therefore, that nursing faculty design teaching strategies and curricula that best prepare the students for these profound job requirements. Educators should examine what the fields of cognitive psychology and neurosciences have to offer in terms of teaching and learning in order to optimize student experiences in the classroom.

Traditionally a lecture format is the most common method of presenting the vast amount of didactic content that must be covered in a nursing classroom (Bastable, 2003). It is an efficient method for sharing large amounts of information in a reasonable time frame (Billings & Halstead, 1998). However, lecture may not be the most effective strategy for understanding and long term retention. A passive one-way transmission of knowledge from teacher to learner is unlikely to stimulate the ability to critically think through problems, analyze each situation, and apply the correct interventions in a constantly changing work environment. Nurses must think in a flexible, dynamic manner. Memorization and recitation of discrete facts will not keep patients safe and healthy. The nurse

must constantly use higher cognitive thinking processes and the ability to engage these skills must be nurtured during nursing school.

Cognitive theorists would encourage the use of active, constructivist strategies that allow the learner to build on existing knowledge (Piaget, 1975; Wittrock, 1978). These would include activities that require learners to apply new knowledge to earlier cognitive structures and build patterns of connection that make sense to them. Brain-based learning advocates would encourage the use of teaching methods that stimulate the brain's natural learning ability to constantly change its structure and function in response to external stimuli (Caine & Caine, 1994; Jensen 1998; Jensen, 2000). Once again these strategies would require learners to connect old learning with new in a climate of challenge without threat. Incorporating the knowledge about teaching and learning from both cognitive psychology and the neurosciences would seem to be a promising approach. Nevertheless, there is very little research to actually support the use of brain-based strategies over traditional lecture. Berninger and Richards (2002) caution that "neural science does not yield teaching methods or procedures to impose on students in the classroom without taking into account a good deal of educational and psychological research on learning and teaching over the past century" (p. 6). Clearly further research is needed. The National League for Nursing (NLN) released a mandate in 2003 encouraging nursing faculty to "conduct pedagogical research to document the effectiveness and meaningfulness of innovations being undertaken" (Recommendations for Faculty,

Bullet 5) in order to improve nursing education. The onus is on nursing faculty to support this recommendation.

Purpose Statement

The purpose of this quasi-experimental quantitative mixed design study is to compare the effectiveness of brain-based teaching strategies versus a traditional lecture format in the acquisition of higher order cognition as determined by test scores. A secondary purpose is to elicit student feedback that describes how they feel about the two teaching approaches.

Research Questions

1. Is there a difference in test performance when students are taught according to constructivist teaching strategies versus a traditional lecture format?

    A. Is there a difference in post-test over pre-test gain scores related to type of student or type of teaching method?

    B. Is there a difference in change over time within groups based on type of teaching method?

    C. Is there a difference between course examination scores related to type of student?

    D. Is there a difference between course examination scores related to type of teaching method?

2. How do students describe the two teaching methods when they are taught according to constructivist teaching strategies versus a traditional lecture format?

Definition of Terms

Baccalaureate of Science in Nursing (BS in Nursing);

A baccalaureate of science in nursing requires a four to five year program of study which prepares the student for positions in acute care facilities as

well as home and community-based nursing settings. BS training incorporates the study of nursing theory and practice along with concepts related to management, community health, research, group dynamics, and professional issues. The curriculum includes a broad background of courses in the natural and social sciences as well as the humanities. BS programs are generally found at a University or four year college. The BS is considered the minimum level of entry into leadership roles and is required for admission to graduate study. (Billings & Halstead, 1998, p. 122).

Brain-based instruction or brain-compatible instruction:

Teaching and learning processes designed to work with the brain's built in method for acquiring, storing, retaining, and retrieving information. It acknowledges that the brain changes physiologically in response to learning (King, 1997, p. 276; Caulfield, Kidd, & Kocher, 2000, p. 62).

Cooperative learning:

Learners work together in collaborative groups aimed at achieving shared learning goals. Each member is responsible for his or her own learning as well as for the learning of other group members (DeYoung, 2003, p. 141).

Constructivism:

Constructivists believe that knowledge is built, or constructed, out of an individual's previous and current experiences and derives from that individual's unique cognitive processes (Tippins, Tobin, and Hook 1993, p. 223).

Higher order cognition and learning:

Based on Bloom's (1956) taxonomy of six categories of learning: knowledge, comprehension, application, analysis, synthesis, and evaluation. For purposes of this study, higher order categories refer to the last 4 categories: application, analysis, synthesis and evaluation.

Lecture:

Teacher directed presentation of content to students usually accompanied by some type of visual aide or handout (Billings & Halstead, 1998). For purposes of this study, "straight lecture" refers to teacher directed instruction. Material was presented in a straight forward manner with the use of power point slides and student outlines.

Learning:

A change in a person's knowledge and behavior that has been caused by experience (Slavin, 1998).

The growth of dendrites within the brain to form new or enriched neural connections. (Smilkstein, 2003).

Medical-surgical nursing

Care of adult individuals who are experiencing an acute or chronic pathological episode or disease process.

Neuroplasticity:

The functional organization and reorganization of the brain and its structures that occur through learning. (Smilkstein, 2003, p.78; Steward, 1993, p.13). Term coined by Konorski, a Polish neurobiologist in 1948 (Hebb, 1969).

Neuroscience:

The study of the human nervous system which incorporates the brain, spinal cord, and autonomic nervous system.

Registered nurse (RN):

Registered nurses are prepared either through a baccalaureate program; a two- to three-year associate degree in nursing program; or a three-year hospital training program. All take the same state licensing exam.

Second degree nursing student

A student enrolled in a nursing program who has a baccalaureate in another field of study.

Traditional baccalaureate nursing student

At the University of Northern Colorado a student who has completed two years of pre-requisite pre-nursing course work as well as the majority of his or her core university courses is eligible to apply to the School of Nursing. A traditional student enters the program during the junior or senior year of college.

Assumptions

There is an assumption that exams can be constructed to test higher level cognitive learning and that scores actually measure learning. There is an assumption that the sample in this study is representative of a typical group of baccalaureate medical-surgical nursing students in Colorado and perhaps in the United States.

Delimitation

This study is confined to nursing students at a University in northeastern Colorado who are enrolled in two sequential medical-surgical nursing courses, Nursing 385: Episodic Alterations in Adult/Child Health Theory 1, and Nursing 386: Episodic Alterations in Adult/Child Heath Theory 2. These students are matriculating through these courses in the spring of 2008.

Limitations

The sample size is small: 36 students in the second degree group and 36 in the traditional group for a total of 72 participants. The findings may not be generalizable to students in other types of nursing education programs. However, nursing programs have similar accreditation standards and upon graduation all nurses must pass the same qualification examination. Thus curricular content will be similar in all nursing programs.

Significance of the Study

The National Advisory Council on Nurse Education and Practice (NACNEP) has outlined the role of the nurse. Registered nurses are expected to manage care along a continuum, to work as part of an interdisciplinary team of health care providers, and to incorporate clinical expertise within the context of available community resources. According to the NACNEP (2004):

> The increased complexity of the scope of practice for RNs requires a workforce that has the capacity to adapt to change. It requires critical thinking and problem solving skills; a sound foundation in a broad range of basic sciences; knowledge of behavioral, social and

> management sciences; and the ability to analyze and communicate data (p. 2).

The United States and, in fact, the world is facing a critical and growing shortage of qualified nurses. The American Association of Healthcare Executives (2004) reported that 72% of hospitals were experiencing a nursing shortage with longer average time needed to fill vacancies. A July 2002 report by the Health Resources and Services Administration estimated that 30 states had shortages in 2000 and projected the shortage to grow to 44 states by the year 2020. Approximately 126,000 nursing vacancies currently exist in United States hospitals and by the year 2020 there will be a 20% shortage of nurses in our nation's health care system (American Hospital Association, 2001). The aging population and the growth of technology have lead to sicker and needier patients in all health care settings. The reality of the nursing shortage is that new graduate nurses must rapidly acclimate to workplace challenges at a time when patient acuity is escalating.

The challenge for nursing faculty is to utilize teaching strategies that facilitate higher order learning so that the future RN workforce can incorporate a broad knowledge base with an ever changing work place. Expert nurses have a wealth of experiences from which to draw in reacting to new situations. New novice nurses lack that depth of knowledge. Faculty need to perfect ways to prepare new nurses to quickly and accurately "think on their feet" so that they can adjust to rapid and often life-threatening alterations in the well-being of their clients while they develop confidence in their ability to perform in a safe and appropriate manner regardless of the situation. The knowledge and skills

required by the modern day nurse cannot be memorized and recalled for each and every situation. Rather the nurse must be prepared to respond to an innumerable number of challenges, often experienced for the first time, on a day to day basis. Such demands require the ability to *analyze* each situation, *synthesize* a plan of action, *apply* underlying knowledge and experience in performing the appropriate intervention, and *evaluate* the results. In other words, nurses must utilize higher cognitive levels of thinking in each work situation.

Brain-based teaching advocates believe that the answer is to lay the groundwork for creating rich neural connections that can be continually sharpened and re-focused as the need arises (Caine & Caine, 1994; Smilkstein, 2003). Unfortunately, while neuroscientists can point to how learning changes the brain's structure educators have been left to interpret these findings and find ways to implement them in the classroom (Zull, 2002). Cognitive psychologists developed the concept of learning as a constructive activity based on the work of Piaget (1975). He theorized that assimilation, accommodation, and construction of knowledge were the primary processes of learning. A learner constructs new knowledge by building on an internal foundation of existing knowledge through a personal interpretation of experience. Both cognitive and neurological approaches emphasize process over product in that learning is an ongoing and continuous modification of behaviors or neural structures. Advocates in both fields speak to the importance of bridging new learning with previously established knowledge. Constructivist teaching strategies have evolved to stimulate the brain's natural learning ability as the learner builds and enriches

his/her knowledge base. Utilizing such strategies may enable educators to bridge the gap between neurological and cognitive sciences and hands-on teaching and learning.

The purpose of this study is to examine what happens when the educator incorporates research findings from these two fields of study into the classroom setting. It is important to research whether or not constructivist teaching and learning activities result in improved student performance. It is also useful to discover how the students feel about this type of learning. As nursing education specialist Em Bevis (2000, p. 78) points out, "Learning is the responsibility of the student" and faculty are responsible for creating an optimal environment in which learning can occur.

This study will add to the body of knowledge regarding the use of brain-based teaching strategies in the classroom. It will fill in gaps in the body of research regarding the use of such strategies in higher education and, more specifically, nursing education. The results will help to influence future practice and research in nursing education.

Researcher's Perspective

I have always been interested in teaching and learning. One of my undergraduate degrees was in secondary education with an emphasis in both English and Social Studies. While I never actually taught either subject in a secondary school I continued to have a passion for education. I have worked as a nurse for many years and one of the most important aspects of nursing is

educating patients, their families, and the community at large. While working as a nurse I found myself moving more and more into staff education and eventually got my Master's Degree in nursing which opened the door for me to teach at the college level.

I feel fortunate to have had an education background because I have been able to bring those ideas and skills into both the undergraduate and graduate classes that I teach. It is a sad fact that the majority of college level educators have no education background. They are content specialists but are not always able to teach that content in the most effective manner. What I learned in college was based on the behaviorist theories of B. F. Skinner and the cognitive psychologists Jean Piaget and Jerome Bruner. Over the past few years my attention and interests have been captured by research being done on brain development and how structural changes in the brain actually reflect learning. In my mind the intuitive and brilliant work done by cognitive psychologists' blends very nicely with the stupendous discoveries being made in the field of neuroscience. The research from both perspectives has much to offer today's educator. The time is ripe for research into how we can bridge and implement recommendations from both fields of study.

I have the wonderful privilege to teach in an exemplary school of nursing. We have master's degree tract, as well as a post-baccalaureate certificate program, both aimed at nursing education. Over the last four years our school has developed a PhD program in nursing education. Thus, my colleagues and directors recognize the importance of knowing how to teach, not just what to

teach. The time is certainly ripe to develop research programs aimed at nursing pedagogy.

Teaching is my passion and I want to continue to grow as educator. I believe that I am a gifted teacher. My class evaluations consistently support that belief. However, as I look at my classes each day I struggle to find ways to teach that will actually lead to a high-level of learning difficult concepts and content. The better my students grasp and fully understand what I teach the better they will be able to take that knowledge and apply it in the clinical area, sometimes under emergent and critical conditions. I don't want to incorporate new strategies unless I believe that they will be beneficial. I want to be sure that incorporating constructivist pedagogy is, in fact, effective. I also want to know how my students feel about various teaching strategies. I have always believed that when students enjoy learning they actually learn better. Thus, I am highly motivated to explore these topics more fully. This mixed-design study will help me explore these issues. I envision this as the first of many studies that I will do to explore the application of a variety of brain-based, constructivist pedagogies.

CHAPTER TWO:

REVIEW OF LITERATURE

Introduction

The purpose of this study is to compare the effectiveness of constructivist teaching strategies versus a traditional lecture format in the acquisition of higher order knowledge as determined by test scores. A second purpose is to elicit student feedback regarding their feelings about the two teaching approaches. Chapter Two is a review of the literature related to learning research from both cognitive and neurological sciences and how that research can be applied to classroom teaching. The first section of this chapter reviews the structure and function of the brain and how the growth of new dendritic branches represents learning. The interconnectedness of individual brain structures, the concept of neuroplasticity, and the impact of emotions on learning are included in this section. Smilkstein's (1993) Natural Learning Process based on the theory that learning equals dendritic growth is also described in section one. The second section examines cognitive learning theories and the concept of constructivism. Arguments for and against the use of constructivism in the classroom are detailed. The third section examines the link between cognitive and neuroscience research and its application to teaching and learning. The fourth section focuses on the application of research to course design and implementation. Specific types of constructivist teaching strategies are described: cooperative learning, jigsaw, and concept mapping. In the final section a conceptual model is depicted supporting this proposed research study.

Understanding the Brain and Brain-Based Learning

Anatomy and Physiology of the Brain

The central nervous system is made up of the brain and the spinal cord. The brain is only approximately 3 pounds of matter. This small, compact organ which is made up of concentrated and interwoven circuitry houses the controls for all of the cognitive, emotional, and physical attributes that define human life (Hooper & Teresi, 1986). Radiographic imaging techniques have made it possible to visualize the various structural components of the brain as well as understand how different regions are specialized for different functions. In fact, neural pathways for many higher functions, such as learning, have been precisely mapped (Donaldson, Petersen, Ollinger, & Buckner, 2001; McDermott, Jones, Petersen, Lageman, & Roediger, 2000; Shulman, Ollinger, Linenweber, Petersen, & Corbetta, 2001).

The nervous system is made up of two different types of cells: glial cells and neurons. There are a vast number of both of these cell types in the brain. It has been estimated that there are approximately 100 billion neurons and probably 10 times that many glial cells throughout the human nervous system (Nolte, 2002). In the brain, glial cells nourish, support, protect, and cleanse the neural networks. In fact, the term "glia" is derived from the Greek word for "glue" (Nolte, pg. 22). Glial astrocytes provide mechanical and metabolic support so that the neurons can function properly. Phagocytic microglia cells remove pathogens and neuronal debris. Ependymal glial cells produce cerebrospinal fluid which baths and cushions the brain and spinal cord and Schwann cells and

oligodendrocytes are glial cells that produce myelin to sheath neurons in the white matter of the nervous system. The myelin sheath allows for a rapid transmission of electrical impulses. Nerve cells that are non-myelinated conduct impulses at a much slower rate (Kandel, Schwartz, & Jessell, (2000).

The neuron, or nerve cell, is the actual cell type responsible for all conscious and unconscious activity in higher life forms. Neurons rapidly convey information via a system of chemical and electrical mechanisms. Neural structures composed of neurons and their supportive glial cells collect, integrate, conduct, and transmit information throughout the body (Kandel, Schwartz, & Jessell, 2000). Neurons perform a tremendously wide variety of actions so there is a great deal of variation in neuronal structure. However, all neurons contain certain common regions: the cell body, dendrites, the axon, and presynaptic terminals (Hentschel & Fine, 2003). The cell body, or soma, contains the nucleus which is the cell's genetic storehouse, and an area called the endoplasmic reticulum where proteins are synthesized. Arising from the cell body are the dendrites and the axon. A neuron may have from one to many thousand dendritic extensions. They branch out in a tree-like formation and perform the important function of receiving incoming signals from other nerve cells. These signals are transmitted to the cell body. The axon carries information away from the cell body to other neurons or to muscle cells. Therefore it is the junction of the axon with the dendrite that allows for the transmission of information. Researchers for many years have concluded that neurons can be lost through age and injury never to be replaced (Kandel,

Schwartz, & Jessell). However, axons and dendritric branches continue to grow and develop throughout life if given the proper stimulation (Greenough, Larson, & Withers, 1985; Segal, Korkotian, & Murphy, 2000). In a study of axodendritic structural plasticity Mel (2003) points out that "Axons, dendrites, and spines are strikingly dynamic structures" (p. 275). He further goes on to describe how dendritic spines emerge within minutes in vitro and in vivo conditions and that "large-scale growth and remodeling of axonal and dendritic arbors and/or proliferation of new spinous synapses can occur in the adult brain within days." (p. 275). Genes determine the basic structure of the brain, but interactions between the brain and the environment can greatly alter both its ultimate make-up and function (Ratey, 2002). The environmental conditions necessary to create these changes will be discussed in later sections.

Neurons and glial cells are organized into specific regions in the brain. These regions are responsible for a wide variety of functions. Brain function can be more clearly understood if one examines how this vital organ evolved. The modern human brain has evolved into three major areas. The hindbrain was the first area to evolve and is the first to appear in prenatal development. This area is located in the lower part of the brain and is composed of the medulla, pons, and cerebellum (Zull, 2002). The hindbrain's function is to regulate many of the basic unconscious physiological processes that sustain life. Centers that drive and control breathing, heart rate, and digestion are all located in the medulla oblongata. The pons serves as an information conduit about movement between the cerebral hemispheres and the cerebellum. The cerebellum modulates the

force and range of movement and is integral to the learning and retention of motor skills (Ormrod, 2004). All of the functions of the hindbrain are necessary to sustain basic life functions and therefore develop first.

The midbrain is the next brain structure that appears in both evolutionary and prenatal development. It sits directly on top and slightly forward of the pons. Within the midbrain lies the reticular formation, or reticular activating system, which plays a vital role in maintaining attention and wakefulness. This later region is especially essential because it serves as a conduit between the outside environment and the cortex and alerts the brain to potentially important stimuli (Ormrod, 2004).

The last structures to form are located in the forebrain which resides in the front and upper portions of the brain. This is the home of the diencephalon, the cerebral cortex, and the limbic system. The diencephalon resides between the two cerebral hemispheres where it is well protected. It houses the thalamus and the hypothalamus. The thalamus processes the majority of the information reaching the cerebral cortex from the rest of the nervous system. The hypothalamus regulates the body's autonomic, endocrine, and visceral functions in order to maintain the body's internal environment within a healthy physiological range. This is known as homeostasis (Nolte, 2002). The cerebral hemispheres consist of two components: the cerebral cortex and the three deeply protected structures of the limbic system. These structures are of vital importance in the acquisition of memory and all high level cognitive functions. They are also the seat of human emotions. Benes (1994) postulates that the neural networks

connecting the limbic system and the cortex are responsible for the integration of emotion with cognition. It is this connection that interweaves emotions, attention, motivation, and the ability to plan and react logically by way of complex behavioral responses. In other words, it helps define the human condition. A more detailed description of these crucial structures follows.

The limbic system is a cluster of tissues essential to learning, memory, emotion, and motivation. There are two structures within the limbic system that are essential to learning and emotional development and stability. The hippocampus is intimately involved in attention, conscious learning, and cognitive memory formation. The amygdala is especially important in mediating inherent as well as learned emotional responses, particularly fear, anger, and anxiety (Kandel, Schwartz, & Jessell, 2000). The components of the limbic system developed at an early stage of vertebrate evolution (Nolte, 2002). The location of this region of the brain allows it to serve as a bridge "between autonomic and voluntary responses to changes in the environment" (Nolte, p. 560).

Residing in close proximity to the limbic system is the basal ganglia. Neurological circuitry links this area with the cerebral cortex, the thalamus, and the limbic cortex. The basal ganglia secretes two neurotransmitters, Gamma-aminobutyric acid (GABA) which has an inhibitory effect and dopamine which is excitatory (Nolte, 2002). Together these substances help control the fluidity of skeletal muscle movement. Dopamine also exerts an influence in the limbic system by stimulating pleasure pathways.

The cerebral cortex is separated into two hemispheres. Each hemisphere is divided into four lobes. The frontal lobe, as its name implies, lies in the front of the cranium. Contained within this most vital of structures are a number of sections that control voluntary movement, language and personality. The motor cortex and premotor cortex contain descending motor pathway neurons. These are responsible for the initiation and control of voluntary motor movements. Broca's area, located in the frontal lobe, is vital to the production and understanding of both written and spoken language. The large prefrontal cortex contains all higher cognitive functions. Damage to this area generally leads to changes in personality and the administrative functions of foresight, insight, and cohesive planning (Nolte, 2002).

The two parietal lobes sit directly behind and adjacent to the frontal lobes. The parietal lobe has three main functions based on the structures housed therein (Nolte, 2002). The sensory cortex lies directly behind the motor cortex of the frontal lobe. Tactile and proprioceptive information is processed within this structure. Other portions of the parietal lobe are concerned with perceptions about spatial orientation. The inferior, or lower, parietal lobe, in conjunction with the temporal lobe, is concerned with the comprehension of speech.

The temporal lobe contains the primary auditory cortex which is essential in the production, as well as contributing to the comprehension, of speech. This important area is known as Wernicke's area. The rest of the temporal lobe is involved in higher order processing of vision. The occipital lobe is devoted to

visual perception. Both the primary visual cortex and the visual association cortex are located in the rear lobe of the brain (Nolte, 2002).

The two hemispheres of the brain are connected by a dense band of neural tissue called the corpus callosum (Nolte, 2002). This massive bundle of nerve fibers is essential for transmitting information from one side of the brain to the other. While the right and left hemispheres have similar structures they are specialized for different functions. Language, for example, tends to be primarily located in the hemisphere that is dominant, although some language functions are found in both sides. Right-handed people have dominant left hemispheres and left-handed people have dominant right hemispheres (Kandel, Schwartz, & Jessell, 2000). Since the majority of people are right-handed the majority have a dominant left hemisphere. This fact becomes especially apparent in individuals who have suffered from a Cerebral Vascular Accident (CVA) on one side or the other. There is also evidence that the dominant hemisphere in an individual may contribute to certain personality traits. Sperry (1952) won the Nobel Prize for his animal research in separating the two hemispheres. He found that the left hemisphere directed verbal activities and tended to process information in a more analytical and sequential way dealing with discrete data first before putting the pieces together. The right hemisphere, on the other hand, was more involved in visual data and tended to process information in a more intuitive and creative way, focusing on the whole picture rather than concentrating on details. The corpus callosum helps unify these two aspects of an individual's personality. While personality differences may be explained by this concept of hemispheric

dominance, the two hemispheres are elegantly coordinated in the tasks of thinking and learning (Ormrod, 2004). The two hemispheres also play a part in memory formation and retention. Recall of discrete facts, known as semantic memory, is controlled by the left-front hemisphere. Episodic memory, which is the recall of whole pictures, or stories, is controlled by the right-front hemisphere (Zull, 2002).

Interconnectedness of Brain Structures

As one can clearly see, the brain is made up of a number of discrete structures, each with its own function and purpose. Nevertheless these highly complex structures are able to work efficiently together and adapt and respond to ever changing internal and external stimuli. The brain is able to process information in many different areas and respond in an organized and meaningful manner. For example, the daily activities of paying attention, learning, creating memories, and carrying out motor skills are all handled in multiple sites in the brain (Kandel, Schwartz, & Jessell, 2000). Important functions such as attention, hearing, speaking, and moving are also handled in a variety of areas and yet a person can communicate in a fluid manner. In another example, the sensory cortex receives information first in the form of the five senses (Zull, 2002). This information is then processed in different locations including the hippocampus and frontal lobe. These structures determine how the individual will respond to the incoming data as well as what information will be stored as memory. Memory storage also takes place in diverse structures including the amygdala,

hippocampus, prefrontal cortex, and cerebellum (Sprenger, 1999). Processing, filing, and reacting to incoming data, as well as incorporating it with what is already known is the result of the dynamic structure and function of dendritic networks. Any single neuron is likely to have hundreds, if not thousands, of synapses with other neurons throughout the central nervous system (Kandel, Schwartz & Jessell, 2000). Evolution and genetics provide the basic building blocks that enable the brain to function in such a remarkable way. The environment in which an individual develops and lives helps to determine further brain enhancement or deterioration.

Dendritic Growth and Connections

Learning occurs when new neural networks are established (Wolfe, 2001). When incoming information is received by dendrites an electrical impulse forms in which an exchange of sodium and potassium ions occurs along the neuron to the end of the axon. If the impulse is powerful enough specific chemicals are released into the synaptic cleft between the axon and the next dendrite or dendrites. These chemicals are called neurotransmitters (Nolte, 2002). If this nerve impulse transmission is repeated often enough it produces a new neuronal network by stimulating the growth of dendritic branches. If it rarely fires, those branches will be lost (Zull, 2002). Hebb (1969), a pioneer in neurobiology in the mid twentieth century proposed the idea that when synapses are active, they get stronger. In 1964 Diamond was able to demonstrate statistically significant anatomical differences in the cerebral cortex of male and female rats depending

on the type of environment to which there were exposed (Diamond 1967). The cortexes in the experimental population of rats who lived in a setting where exploration, problem solving, and variable stimulation existed became thicker than those of the control rats. They also had more dendritic branching, and larger cell bodies. Diamond's ongoing work, as well as subsequent research by many other neuroscientists with both rats and humans, has continued to show the malleability of the brain (Caine & Caine, 1994; Jensen, 1998, 2000; Smilkstein, 1993, 2003; Draganski, et al. 2004). It was once believed that a human being was born with as many neurons as he/she would ever have and that throughout life neurons would be lost, never to be replaced (Diamond & Hopson). It is true that through misuse and disuse thousands of neurons die each day (Howard, 1994). Scientists once concluded, therefore, that a gradual decline in mental abilities was simply part of the aging process. It is now known that such a dismal outlook does not have to be true (Diamond & Hopson, 1998; Caine & Caine).

The ability to actually track brain activity has confirmed the earlier findings of Diamond and others (Goldman-Rakic, Bourgeios, & Rakic, 1997; Huttenlocher & Dabholkar, 1997; Rakic, Bourgeois, & Goldman-Rakic, 1994) by demonstrating changes in the number and density of dendritic networks. The term "neuroplasticity" describes the brain's amazing ability to adapt and change secondary to the type of stimuli to which it is exposed. This phenomenon is discussed in the next section.

Neuroplasticity

The term, neuroplasticity, was first coined by Konorski, a Polish neurobiologist in 1948 (Hebb, 1969). Diamond and Hopson (1998) use the term to refer to the fact that the brain continually reorganizes itself throughout life in response to both internal and external stimulation (Purves, 1994; Fischer & Rose, 1998; Zull, 2002). While new neurons are, in fact, not being formed the connections between neurons are constantly changing (Caine & Caine, 1994; Diamond & Hopson, 1998; Jensen, 1998; Smilkstein, 2003). There are multiple animal studies that demonstrate the effect of environmental conditions on dendritic growth (Quartz and Sejnowski, 1997). Valverde (1997) found that mice reared in the dark grew new dendrites in the visual cortex after they were placed in a lighted environment. In a study that substantiated Diamond's earlier work, rats reared in a complex environment developed more dendritic branches than did animals reared in a simple environment (Comery, Stamoudis, Irwin, & Greenough, 1996). In another animal study, the brains of songbirds demonstrated an increase in the number, size, and the spacing of neurons in the areas that control song at the beginning of the breeding season (Tramontin & Brenowitz, 2000).

It is not possible to study humans in the same manner as mice, rats, and songbirds. Much of what we believe is based on inference and on the use of scanners that can show what is happening at any one point in time. It is difficult to demonstrate that learning involves synaptic plasticity in humans (Thompson, 1992). There is, however, a significant body of research detailing how the

human brain develops in utero and during childhood. By the eighth week of pregnancy, the brain has developed the hindbrain, the midbrain and the forebrain (Diamond & Hopson, 1998). Brain structures form as neurons migrate to specific areas in a predictable manner. There is a predetermined pattern that dictates how and when this occurs. Proper migration can be adversely affected by such things as hormones, growth factors, cell adhesion molecules, and a variety of substances in the mother's blood (Ratey, 2002). At seven months in utero neural pruning begins. Over the next 23 months approximately fifty percent of cerebral neurons and forty percent of synaptic connections are eliminated. Pruning continues into early adolescence. Throughout a child's maturation there are a number of critical periods during which additional pruning and the formation of new connections takes place (Diamond & Hopson). These critical periods include the first year of life, ages two to four, and around six years of life (Epstein, 2001). The next critical periods occur from ten to twelve and fourteen to sixteen. Additional research (Hudspeth & Pribram, 1990) indicates that there may be another critical period between eighteen and twenty years of life.

This research has been based largely on the use of Magnetic Resonance Imaging scans. Gogtay, Giedd, Lusk et al. (2004) observed that brain development progresses in a posterior to anterior (back to front) manner. In light of the specific brain structures involved this finding indicates that cortical areas involved in higher function cognitive activities develop only after the lower-order sensorimotor structures. Gogtay, Giedd, Lusk et al. postulate that brain maturation proceeds in this order: 1) motor and sensory areas, 2) spatial

orientation, speech and language development, and attention, 3) executive functions and motor coordination. Their findings were based on a longitudinal study of thirteen children ages four through twenty-one. Anatomic brain MRI scans were taken every two years.

There is less data available on how brains continue to grow or change during adulthood. Some of the most compelling evidence comes from studies of individuals who have various disabilities. For example, in separate studies Blakemore (1977) and Friedman and Cocking (1986) demonstrated that individuals who are deaf develop different neural connections than those found in hearing individuals. Their findings demonstrated that the pathways normally used for hearing have been altered to access the visual cortex which would be needed for reading sign language. Research studies done on individuals who have suffered brain damage from cerebral vascular accidents or have had portions of their brain removed have contributed to our understanding of neuroplasticity. Bach-y-Rita (1980, 1981) and Crill and Raichle (1982) were able to show that such individuals could, after a long period of training, regain functions that had been lost. This demonstrates that new, alternative, neural connections and pathways were made.

The Natural Human Learning Process

Smilkstein (1993) conducted landmark research over a period of several years on 5,000 students from kindergarten through graduate school. The subjects were asked to think about something they felt that they had learned well

outside of school. They were to describe how they had learned it, what the progress of their learning was, and how they mastered it. The results were surprisingly consistent for each group studied. The subjects reported six stages of learning. During the initial stage interest, motivation, and need provided the impetus to continue. Stage 2 was characterized by trial and error practice and experimentation. Stage 3 involved ongoing practice with increased levels of difficulty and beginning to take risks. During stage 4 the subjects were refining and applying their knowledge and skills and seeking feedback. In the final two stages the subjects continued to enrich their knowledge by making connections with previous knowledge and with others. At that point they were not tempted to give up, and many begin to teach others. After analyzing the data Smilkstein proposed five educational rules for developing new dendritic growth in humans. As Smilkstein (1993) states: "Their growth *is* learning" (p. 3).

The first of these rules is: *"Dendrites, synapses, and neural networks grow only from what is already there"* (Smilkstein, 1993, p. 71). In other words, as new information is introduced, new dendritic connections develop from pre-established neural beds. Westwater and Wolfe (2000) point out that human beings are simultaneously bombarded by thousands of internal and external stimuli. The brain decides what data are important and worth processing based on recognizable patterns or features. The brain must constantly search for meaning as a survival mechanism (Caine & Caine, 1994). It seeks patterns in new information based on what it already understands. It reviews all the data previously known and formulates new understandings for incoming data. The

brain is designed to solve problems and seek answers. It organizes and categorizes new and old information into patterns. It resists patterns that are meaningless (Caine & Caine). Thus new information must be able to connect with previously learned material. Hewson and Hewson (1989) state that humans are: "knowing, active, purposive, adaptive, self aware beings whose knowledge and purposes have consequences for their actions. They must construct their own knowledge, using their existing knowledge to do so" (p. 192).

Smilkstein's (2003) second rule is: *"Dendrites, synapses, and neural networks grow for what is actively, personally, and specifically experienced and practiced"* (p.71). The old adage "practice makes perfect" reflects the reinforcement of neural pathways and connections that occurs with repeated stimulation. The pathways become more and more efficient with repeated electrical firing. However, mastery of information can place the brain on "automatic pilot." As Jensen (1998) points out, "at the level of 'mastery,' the brain is coasting" (p. 36). Using functional magnetic resonance imaging (fMRI) Poldark et al. (2001) examined memory pathways in the basal ganglia and the medial temporal lobe. They discovered that neurons in the basal ganglia were activated when the subjects were engaged in seeking answers and making cognitive associations. On the other hand when the subjects were asked to memorize associations, rather than discover them on their own, the basal structures were less active while the medial temporal lobe showed increased activity. Since pleasure pathways also exist in the basal ganglia it is possible that active learning is more likely to stimulate sensations of pleasure. Given these findings it

would seem wise for the educator to use a variety of teaching strategies that actively engage learners. Classroom strategies should utilize active participation by learners and incorporate a number of different approaches to gaining understanding of the material thereby providing more enriched "practice" time. In effective classrooms students actively seek meaning from what is being taught. They do not simply memorize facts

A third rule, *"Dendrites, synapses, and neural networks grow from stimulating experiences"* addresses the brain's need for novelty and varied stimulation (Smilkstein, 2003, p. 72). It is an evolutionary necessity for the brain to be alert to new stimuli and decide whether or not a threat exists. A number of studies have demonstrated that learning is enhanced when an individual is faced with discordant information that questions preconceived biases and prejudices (Piaget, 1975; Smilkstein, 2003). When an individual is faced with circumstances that cannot be explained according to earlier beliefs he/she must work to create new patterns of understanding (Gurin, Nagda, & Lopez, 2004). Students must occasionally deconstruct previous knowledge in order to master new information (Kinghorn, 1991). Spence (2001) believes that "learning means breaking, making, and remolding connections in our brains" (p. 16). Therefore, educators must constantly challenge students to examine discrepancy and discontinuity in their thinking.

Smilkstein's (2003) fourth rule states, "*Use it or lose it*" (p. 72). If a person stops doing something that he/she previously learned, the neural networks are pruned and some or all of the information may be lost. Diamond (1967)

observed that with disuse, dendritic "trees" and spines disappear rapidly. This tendency to eradicate unused tissue enables the brain to save energy for other essential survival activities. The basis of learning, then, is growing more synaptic networks throughout the brain while preserving those that already exist.

The fifth rule (Smilkstein, 2003) is: *"Emotions affect learning"* (p. 73). This compliments earlier work by MacLean (1978) who built on the notion that the human brain consists of three separate brains: the old reptilian, the old mammalian (limbic system), and the neocortex. The first of these is responsible for instinctual behaviors, the second is the locus of emotional responsivity, and the third is the site of higher-level cognitive activities. MacLean theorized that under threat the brain "downshifts" from conscious thinking to more instinctive behaviors. At such times, new learning is impaired and access to any higher order processing is temporarily blocked. A brain-friendly educator would work to reduce threats. A number of researchers second this recommendation. Hart (1983) emphasizes this by stating that the absence of threat is essential for learning. Likewise, Sylwester (1995) observed: "Emotionally stressful school environments are counterproductive because they can reduce the student's ability to learn" (p. 77). Neuroscience research also suggests that the brain learns best when confronted with a balance between stress and comfort, in other words, high challenge and low threat (LeDoux, 1996). Caine and Caine (1994) call this a state of "*relaxed alertness*" (p. 70).

The Impact of Emotions on Learning

Emotions have a powerful effect on learning. This is especially true if an individual has developed neural networks from repeated negative experiences. An individual can become so accustomed to negative feedback, particularly during the critical growth periods, that his or her brain develops a well triggered network of failure (Smilkstein, 2003). Learning in a person who has received mostly positive reinforcement can also be adversely affected by transient periods of anxiety and fear. This has to do with the influence of the structures which regulate emotions.

The limbic system plays a vital role in both memory formation and emotional responsiveness and this area is closely connected to the cerebral cortex including areas in the frontal cortex responsible for higher order thinking (LeDoux, 1996; Goleman, 1995). Sylwester (1994) claims that the limbic system in general "is powerful enough to override both rational thought and innate brain stem response patterns. In short, we tend to follow our feelings" (p. 63). Turkington (1996) believes that the amygdala, one of the structures in the limbic system, plays the primary part in imbuing an emotional meaning in the formation of memories. Zull (2002) calls it the 'fear region" (p. 57). In fact the amygdala becomes less active when the individual is experiencing positive emotions. Zull explains that the amygdala is also less active when the individual is involved in non-threatening cognitive tasks.

The brain interacts with the body directly through neuronal connections and through the release of chemicals. Emotions trigger the release of

neurotransmitters and hormones that bathe the brain and body. Both avenues lead to physiological reactions that enable the individual to respond in a way that preserves life. The hypothalamus, limbic system, cerebral cortex, and the sympathetic nervous system all play a part in how a person interprets and responds to strong emotions (Sylwester, 1994; LeDoux, 1996). The hypothalamus plays a major role in responding to actual and perceived threats by coordinating behavioral responses to insure homeostasis, i.e. internal stability, (Kandel, Schwartz, & Jessel, 2000). The amygdala and the limbic system work through the hypothalamus to control the autonomic nervous and endocrine systems. The sympathetic branch of the autonomic nervous system stimulates what is known as the "fight or flight" response. Catecholamine neurotransmitters epinephrine and norepinephrine released from the adrenal medulla increase blood flow to the heart, lungs, and skeletal muscles. They also cause dilation of the pupils and the bronchial tubes. Catecholamines stimulate the brain stem to increase respiration, heart rate, and blood pressure in order to provide oxygen rich blood to vital organs and skeletal muscles (Lewis, Heitkemper, Dirksen, O'Brien, & Bucher, 2007). This visceral reaction designed to ensure survival of the organism does not require an immediate cognitive response. In fact the innervation of the autonomic nervous system occurs below the cognitive structures of the brain. Thus, thinking about and consciously reacting to a threat lag behind the physiological responses to it.

The hypothalamus is part of the neurological system but it exerts control over much of the endocrine system through its close connection with the

endocrine portion of the pituitary gland. In addition to playing a part in stimulating an autonomic response the hypothalamus sends chemical messages via the pituitary and adrenal glands to stimulate the release of cortisol from the adrenal cortex. Cortisol is a potent hormone that suppresses inflammation and raises blood sugar. It modulates the stress response and helps maintain homeostasis (Lewis et al. 2007). Unfortunately high circulating blood levels of cortisol can, over time, damage or destroy cells in the hippocampus leading to memory impairment (Bruner et al. 2006). Ohl, Michaelis, Vollmann-Honsdorf, Kirschbaum, and Fuchs (2000) investigated what chronic stress versus long term cortisol administration did on the hippocampus volume and memory processes of male tree shrews. Over a fifteen week period they used MRI imaging and saliva cortisol measurements to track the actual level of cortisol in both groups of shrews. They found that both groups suffered adverse effects on the hippocampus memory pathways and a decrease in hippocampal volume after four weeks. Memory impairment was noted only at the end of fifteen weeks in the exogenous group while in the stressed group of shrews the effect continued for the next two months. At least in tree shrews chronic stress causes a decrease in the size and function of the memory forming structures in the brain.

Powerful stress can shut down cognitive processes as the brain goes into survival mode. Epinephrine is known to suppress higher level functions of judgment and reasoning in the cerebral frontal cortex (Zull, 2002). On the other hand dopamine is believed to play a positive role in cognitive reinforcement learning. Researchers at the University of Colorado studied Individuals with

Parkinson's disease (Frank, Seeberger, & O'Reilly, 2004). They developed a model showing that in pathways stimulated by positive reinforcements "dopamine bursts increase synaptic plasticity" (p. 2). There was a decrease in dopamine release when negative reinforcements were given

Emotions can adversely affect attention, the ability to process new information, react in rational ways, and even form memories. LeDoux (1996) states: "Emotions drive attention, create meaning, and have their own memory pathways" (p. 32). Emotions can influence the goals students set for themselves, what they choose to pay attention to, and how well they are able to process information (Byrnes, 2001).

On the other hand positive emotions can enhance attention and strengthen memory formation. Pekrun, Goetz, Titz, & Perry (2002) reported on seven cross-sectional, three longitudinal, and one diary qualitative studies using the Academic Emotions Questionnaire. The results showed a statistically significant relationship between emotional states and student motivation, ability to learn, method of learning, and academic success. Positive emotional states stimulated memory formation and success while negative emotions interfered with attention and learning. The amygdala is responsible for the fact that memories associated with strong emotions, both positive and negative, are processed into long term memory (Gunn, Richburg, & Smilkstein, 2007). Humans are able to recall distant experiences with remarkable clarity when they are connected to strong emotions. It behooves the educator then to help

students retain what they learn by making learning pleasurable and emotionally memorable.

It is imperative for the educator to take this information seriously when creating a classroom environment that stimulates and promotes positive emotions. Teachers need to promote the emotional health of their students because this will enhance learning. Given (2002) and Smilkstein (2003) suggest creating an atmosphere of acceptance, encouragement, and support in which the student can feel emotionally safe. It is possible to make learning fun and pleasurable though the use of gaming, storytelling, simulations, and sharing (Rieber, Smith, & Noah, 1998). Celebrating successes and incorporating classroom rituals also lighten the mood (Roberts, 2002). The teacher should also be a role model and demonstrate an enthusiasm for teaching and learning (Given, 2002; Greenleaf, 1999). At all times the educator should remember that "emotions drive the threesome of attention, meaning, and memory" (Jensen, 1998 p. 94).

Cognitive Research

Theories of Learning

In the 1920s Marx Wertheimer, Wolfgang Kohler, and Kurt Koffka developed Gestalt theories of learning. Gestalt theorists propose that learning is making a unified whole out of individual parts. Gestaltists believed that learners take meaning from entire patterns rather than from discrete units (Epstein & Hatfield, 1994). In other words the whole is more than just the sum of its parts. Insight into patterns among discordant and disjointed information is an important

principle of Gestaltism. Often through trial and error, human beings create a sense of order out of various stimuli. It is an active process.

Later cognitive theories define learning as an active, cumulative, constructive process that is goal oriented and dependent on the learner's mental activities (Sheull, 1986). Furthermore, learning is seen as an internal process whereby modifications of existing representations of knowledge occur. Learning is described as experiential and is formed by a person's experience of the consequences. Wittrock (1978) believed that students must have the opportunity to discover meaning for themselves through a variety of information-processing strategies rather than have information transferred passively from the instructor.

Cognitive psychologists developed the concept of learning as a constructive activity based on the work of Piaget (1975). Piaget held that assimilation, accommodation and construction of knowledge in the developing child were the primary processes of learning. A learner constructs new knowledge by building on an internal foundation of existing knowledge through a personal interpretation of experience. Piaget identified sequential stages of cognitive growth and development. The child cannot successfully move through the six stages without accomplishing the important learning tasks of the previous stages.

Bruner and Haste (1987) describe "mental mapping" a method by which individuals move through learning experiences. Bruner, Goodnow, and Austin (2003) outline a number of conditions that affect learning based on studies that examined concept-attainment behavior. Subjects were able to learn lists of

objects significantly more effectively if they were told to seek patterns in the lists versus those who were told to simply memorize the lists. They were also more successful if they had the freedom to determine the patterns themselves versus being given those patterns by the researcher. Bruner (1971) suggests that educators must "share the process of education with the learner" (p. 12).

Cognitive learning theories emphasize process over product. Many of the theories identify steps that a learner takes in acquiring knowledge (Blanton, 2004; Bruner, 2003). For example, McGilly (1994) reported on the results of a study that identified six expert strategies learners needed in order to comprehend reading materials. These were understanding the purpose; tapping into previous knowledge; paying attention to relevant versus irrelevant material; examining the content for consistency and for agreement with previous knowledge; ongoing awareness of comprehension of material; and making and testing inferences. This type of study provides support for the concept of active teaching-learning strategies. These stages closely correspond to work done by Smilkstein (1993) who studied the learning process of over 5000 students. Smilkstein's brain-based stages are: motivation and personal connection; naïve processing of experience (seeing how it fit into previous knowledge); more refined processing through trial and error; in depth processing as understanding develops; highly refined processing; and expertise. The emphasis for both the cognitive and the neurological approach is to emphasize process over product and they both speak to the importance of bridging new and established information.

Cognitive psychologists believe that students must take an active role in the learning process. They must see patterns and deduce meanings from the information being provided. Oermann (2004) suggested that "active learning fosters critical thinking because students can explore alternate perspectives, examine different decisions that might be possible in a situation, analyze and weigh consequences of those decisions, and arrive at reasoned judgments" (p.1). Previously learned relevant knowledge can be tapped in order to enable continuing growth of knowledge and skill acquisition. If the foundational development of knowledge or skills is inadequate, it is difficult for a student to understand and master new material (Blanton, 1998). From the neuroscientists perspective a student may lack the necessary dendritic numbers and connections upon which to construct higher-level knowledge (Smilkstein, 2003).

Constructivism

Arguments for Constructivism

The constructivist approach to learning utilizes the concepts of building new knowledge from previously established learning. It is a way of utilizing Smilkstein's rules of learning previously described. Principles of modern constructivist pedagogy have a rich philosophical, psychological, and educational history. The works of Plato, Spinoza, Kant, and Nietzsche (Candy, 1989) address the nature of reality using a constructivist framework. Educational leaders from Dewey, Vygotsky, and Piaget along with cognitive psychologists

Bruner and Feldman have further defined and refined the concept of constructivism (Kozulin, Gindis, Ageyev, & Miller, 2003; Bruner & Haste, 1987).

Constructivists hold that knowledge is built, or constructed, out of an individual's previous and current experiences and derives from that individual's unique cognitive processes (Brooks & Brooks, 1999; McKeown & Beck, 1999; Peters, 2000). In other words, constructivists challenge the idea that there is an objective reality that can be transmitted from teacher to learner. Rather, as Tippins, Tobin, and Hook (1993) point out: "It is an active process in which learners construct knowledge in a way that makes personal sense. And it is a subjective process, as learners draw on their own background experiences to make sense" (p. 223). For the constructivist, the acquisition of new knowledge is built on previous knowledge. Prior learning frames and molds the way new knowledge is processed and retained. Thus, learning is seen as an active process and the role of the teacher becomes one of mediator and guide (Peters; Kinghorn, 1991).

Constructivist teaching strategies have a number of important components (Brooks & Brooks, 1999). Teachers in constructivist classrooms encourage and explore students' points of view. Lessons can therefore be structured around student needs and interests. One goal of a constructivist teacher is to challenge the suppositions students bring to the class. This, again, is done through an exploration of what students know and believe. The instructor helps students relate to the topic being taught in order to engage their full attention and interest. Lessons are structured around large concepts, not discrete facts. The student

then discovers the relevant components of the concepts. Assessment is done in an ongoing, daily manner, and not just through periodic testing. Other important attributes of a constructivist classroom include the following: the use of a variety of interactive teaching strategies; the teacher's acceptance and support of all students to insure that the proper emotional environment exists for learning, i.e. challenge without threat; the teacher serving as a mediator and guide rather than an expert who disseminates knowledge from the front of the classroom. Smilkstein's (1993) "Natural Human Learning Process" which has been used effectively with at risk students incorporates these criteria. Bain (2004) describes effective learning environments that utilize constructivist themes. Other researchers have empirical evidence that such strategies work well in at all levels of the educational continuum (Blanton, 1998; DeYoung, 2003; Peters, 2000; Rideout, 2001; Roberts, 2002; and Weiss, 2000).

Arguments Against Constructivism

There are a number of criticisms directed against the application of constructivist teaching strategies in the classroom. These criticisms fall into two major categories: philosophical and political issues and practice issues.

Philosophical and Political Issues

Brooks and Brooks (1999) point out that traditional educational structures place the teacher as the primary imparter of knowledge. Spence (2001) makes a similar assessment of modern day university classrooms. One of the reasons for

this belief is that students can and should grasp new information as it is presented in the curriculum and that they can learn on demand. High stakes testing as a method of evaluating and rewarding or punishing school districts has ensured that lower grade classrooms will continue to be taught in this manner. The focus in such settings is on the test result products and not on whether actual learning is taking place. Teaching to ensure that test results improve and stay high has led many teachers to focus on discrete facts and figures and not on the process of learning (Brooks & Brooks; Franklin, 2001). Constructivism does not fit into such an educational framework.

Along the same lines, constructivist learning theory is criticized for being too unstructured (Brooks & Brooks, 1999). The emphasis on broad concepts rather than specific facts holds special concern among math and science teachers. Part of the fear among detractors is that if active teaching strategies that incorporate individualized learning are not focused and managed appropriately specific curricular sequences may be abandoned. Along the same line, some educators worry that constructivist strategies lack rigor (Brooks & Brooks). This largely unfounded fear focuses on the fact that constructivist teachers allow students to pursue topics that contain interest and personal relevance.

Another philosophical concern rises out of the bedrock of constructivist philosophy (Peters, 2000). Students construct knowledge in ways that make sense to them personally. Reality is, therefore, relative and open to a variety of interpretations. This type of subjective epistemology threatens those who believe

in objective truths that exist outside the realm of human cognition. This is especially true in the areas of math, science and technology (Winn, 2003). Many scientists believe that there are biological determinants of human behavior that can be discovered through careful experimental inquiry (Pinker, 1997). Others believe that learning is simply too complex to ever fully comprehend (Winn, 2003). There is a paucity of well-designed studies that examine the linkage between brain research, cognitive psychology, and specific teaching pedagogies. Until more data is available the debate over these questions will continue.

Practice Issues

There are implementation concerns expressed by educators interested in exploring constructivist teaching methods (Kinghorn, 1991; McKeown & Beck, 1999; Peters, 2000). First of all, this method of teaching requires that the teacher be the 'guide on the side' rather than the 'sage on the stage.' Giving up the center role in the teaching-learning dyad takes self-awareness and a willingness to relinquish control. Teachers need instruction and guidance themselves as they create constructivist environments. They must have excellent mediation and facilitation skills and these may take time to develop (Kinghorn). McKeown and Beck point out that the constructivist teacher works just as hard as a traditional lecturer only in the former case "the hard work goes toward focusing and eliciting student thinking rather than toward providing information" (p. 27). It is essential for the teacher to create a classroom environment in which students feel comfortable sharing and interacting with others. A constructivist teacher

must be sensitive to each student's previous knowledge and experiences in order to help them construct new knowledge (Peters, 2000). This may be difficult in a large classroom or in classes that meet infrequently. The teacher's own background, experiences, and personality have to be taken into account. There almost certainly has to be institutional support and encouragement provided for teachers wanting to explore constructivist strategies. This may not be forthcoming if the school or district places an emphasis on high-stakes testing.

There are a number of pitfalls once the teacher has decided to incorporate constructivism in the classroom. One of the dangers he/she might experience is responding to student contributions with non-committal comments that detract from the focus of the discussion or activity. The key instead is to respond in such a way that stimulates the class to build and expand on each other's contributions. It is often tempting for the teacher to become too integral to the lesson so that he/she is doing all the connecting and building of ideas (McKeown & Beck, 1999). If the students are reticent, the teacher may feel pressure to dominate the discussion or revert to a straightforward transmission of ideas and facts.

Students must also be acculturated into a constructivist classroom framework. They may come from a more traditional style of education in which information has simply been transmitted. They, too, must learn the techniques and be willing to become full participants. Since constructivist classrooms are student oriented and require a high level of interaction students may feel uncomfortable or threatened. The teacher and students must work together to create an environment that is open, unbiased, neutral, and supportive. For

educators with an enormous amount of material to cover, this adds an additional burden of responsibility. Constructivist activities take longer to carry out than lectures. If the process is not completed adequately in the allotted time students may become frustrated and feel confused. This could lead to negative teacher evaluations (Kinghorn, 1991). Ideally, students move throughout a curriculum that incorporates constructivist techniques at all levels. They then know what is expected of them and have the skills to make full use of the learning opportunities.

Conclusion regarding constructivism

There is a significant body of literature from cognitive psychology, educational pedagogy and the neurosciences that support the theory of constructivism. The exponential amount of knowledge coming from the neurosciences has provided rich support for psychologists and educators who believe that learning is a building process. It seems clearer than ever that each person's view of reality is a compilation of genetics, emotions, the environment, and life experiences. Constructivist teaching focuses on providing the tools for enriched learning that builds on each student's unique foundation of knowledge. However, it is not an easy method to learn or to implement fully. This author believes that a wide range of teaching strategies should be utilized and that constructivism is an important component of many of these strategies. However, the instructor must have the personality traits, the necessary skills, and the willingness to leave center stage if this approach is to be successful. There must

also be institutional support in the form of professional development and a willingness to incorporate constructivist strategies across the curriculum so that students will develop the skills and abilities needed to make the classroom successful. And finally, there must be more research to determine what specific strategies enhance dendritic growth and cognitive development.

The Link Between Cognitive Research and Brain-Based Research

George H. Bush proclaimed the 1990's as "The Decade of the Brain" triggering an incredible onset of research made possible by numerous technological advances (Bush, G.H., 1990). PET (Positron Emission Tomography), MRI (Magnetic Resonance Imaging), and MEG (Magnetoencephalopathy) are modern medical scanners that measure the brain in a variety of ways but all give information about which areas of the brain are active and which areas are dormant at any given time (Kandel, Schwartz, & Jessel, 2000). The MEG, in fact is able to track 4,000 brain measurements per second (Sousa, 2001). What we now know about the brain has totally transformed our understanding of how people learn and retain information. Images from these scanners can be correlated to the activities of discrete regions of the brain. In other words as an individual performs a specific task or thinks about a specific topic the area of the brain utilized in this function can be observed and mapped.

Researchers have also been able to identify specific patterns of dendritic growth which support the concept of constructivism. In 1993 Jacobs, Schall, and

Scheibel (as cited in Gunn, Richburg, & Smilkstein, 2007) found that dendritic growth in human brains were correlated with the individual's background education and avocation. They also noted that the dendrites farthest from the cell body were the most mature and the most able to respond to stimuli from the environment. This complements the constructivist point of view of the cognitive psychologists. The key is to create classrooms that provide opportunities for the construction of knowledge as reflected in dendritic growth and maturation.

Two components of a brain-friendly classroom that honors both neurological and cognitive sciences are an enriched environment and active, student-oriented teaching strategies. An enriched, non-threatening environment with an air of "relaxed alertness" should be the goal (Caine and Caine, 1994, p. 70). Providing an enriched classroom environment and utilizing the brain's natural ability to find meaning through the use of active learning strategies may enable all students to grow new neural networks, strengthen, and enrich older networks and form bridges of information that will enhance their learning. Maintaining the balance between tension and comfort is the goal.

What constitutes an enriched environment? Jensen (1998) believes that there are two components: challenge and feedback. Challenge comes in the form of external environmental stimulation as well the type and level of work assigned. Frequent changes in the classroom's décor, especially if those changes are student generated is important. Challenge incorporates novelty and the opportunity to continue refining older skills and knowledge. New information should be built on old knowledge but allow for enough discordance and surprise

to keep the brain alert. Challenging activities demand that students problem solve, think critically, and determine relevance while engaging in complex cognitive activities. Bain (2004) advises educators to encourage students to "compare, apply, evaluate, analyze, and synthesize, but never only to listen and remember" (p. B8). These higher-level processes demand that students be active participants in classroom learning. Feedback should be specific, provided in a timely fashion and in a variety of ways, and should be learner controlled (Jensen, 1998). Jensen goes on to explain that immediate feedback is generally desirable over that which is delayed. The overall goal is to create a "natural critical learning environment" (Bain, p. B7). This is a classroom in which students examine questions that they find naturally interesting, make decisions, defend their decisions, receive feedback, and rethink their positions. The educator must make sure that students understand how the questions are significant and relate the current topic to some larger issue that is relevant or interesting. Students can then engage in the higher level cognitive processes described above.

Applying Research to Course Design and Implementation

Many authors recommend using a variety of teaching strategies to stimulate active learning in a brain-friendly classroom (DeYoung, 2003; Oermann, 2004; Rideout, 2001; Spence, 2001). Even lecture can be an acceptable teaching method if it incorporates active learning opportunities (Oermann). Short lectures have several advantages. Teachers can draw from sources other than the assigned texts to elaborate important themes. Up-to-date material can be presented. This is especially important in nursing because new

information about disease processes and treatment modalities are occurring almost daily. In preparing for new learning units students often lack the ability to identify what is essential versus non-essential information. An opening lecture can help the student better focus on the most important concepts. Short (15 – 20) minute lecture segments can be followed by interactive activities that give students a chance to process and practice new information. A lecturer can pepper a presentation with questions and case scenarios that elicit student involvement and provide opportunities to establish relevance with previous learning. A variety of questions should be used to elicit a range of responses from those that require memorization and comprehension to higher order queries that require the students to apply, analyze, and synthesize what they are learning. Asking thought-provoking questions can engage student attention and stimulate critical-learning (Bain, 2004; Oermann). This type of lecture with discussion format starts to move the focus off the teacher and content and onto the student and the process of learning.

Increasing the level of interactivity in the classroom has a neurophysiologic advantage. Poldrack et al. (2001) in a study that mirrored the previously described results found by Bruner, Goodnow, and Austin (2003) utilized functional magnetic resonance imaging to observe activity in memory pathways of the basal ganglia and medial temporal lobe of subjects engaged in two types of teaching strategies. When the subjects were engaged in asking questions about the material, forming their own associations, and getting feedback the basal structures were activated. When they were given the

associations and told to memorize them the brain activity shifted into the medial temporal lobe. The basal ganglia contain pleasure pathways. The notion of linking pleasure with learning is exciting. Interactivity, then, would seem to be an important component of a brain friendly classroom. One way to structure an interactive classroom is to use a cooperative learning framework that incorporates constructivist-teaching strategies.

Cooperative Learning Strategies

Group activities can be an excellent way to stimulate active learning (Elberson, Vance, Stephenson, & Corbett, 2001). "The brain is innately social and collaborative" (Brandt & Wolfe, 1998, p. 11). Students can learn from each other, observe other models of successful learning, and learn mediation and facilitation skills when they work in groups (Stage, 2002). Students learn most effectively when they teach others and are able to make immediate use of learning (Sousa, 2001). The teacher can present new material and then instruct the students to work in groups teaching and applying what has just been introduced. Elberson, Vance, Stephenson, & Corbett conducted a descriptive study of nursing students in a pathophysiology cooperative learning course. The students participating in this study demonstrated higher than average scores for all aspects of evaluation and expressed described interdependence and knowledge acquisition.

Khosravani, Manoochehri, and Memarian (2005) conducted a quasi-experimental study examining whether group dynamics improved critical thinking

skills in 60 nursing students at Tarbiat Modarres University in Tehran, Iran. Half of the students participated in eight to ten small group-dynamic sessions during which they discussed selected topics including concepts of family health and the roles of the community health nurse. The control group did not participate in any of the group sessions. All students made their community health home visits and completed visitation forms as assigned. The forms were then scored according to how well they reflected critical thinking abilities. There was a statistically significant difference between the scores for the two groups ($P = 0.0001$) indicating that the addition of group dynamics had enhanced critical thinking abilities in the experimental group.

A study by Johnson & Mighten (2005) compared the impact of lecture notes combined with structured group discussions versus lecture only on test scores in a medical surgical nursing course. The group ($n = 81$) that met and discussed course content with only lecture notes from the instructor had statistically significant higher test scores ($p = < 0.010$) than the lecture only group ($n = 88$). These studies demonstrated an improvement in the ability of students to think critically as measured by test scores and community health written assignments. It is not clear if the assignments or tests were designed to measure higher order thinking. Nevertheless, when evaluated in light of the work done by Poldrack, et al. (2001) actively engaging the student and providing opportunities for group work would seem to be beneficial to learning.

Constructivist Teaching Strategies

The supporters of constructivism would recommend that education occur in an emotionally supportive classroom in which active and interactive strategies are utilized incorporating previous knowledge in an exploration and discovery of new, higher level information (Peters, 2000). The emphasis in such a classroom is on the process of knowledge acquisition, not the end product. Jensen (1998) points out that dendrites grow whether or not the brain is able to come up with answers: "Neural growth happens because of the process, not the solution" (p. 36). *"Dendrites, synapses, and neural networks grow from stimulating experiences"* is Smilkstein's third principle of human learning (Smilkstein, 2003, p. 72). It addresses the brain's need for novelty and varied stimulation. A variety of teaching methods that give students the opportunity to actively question, test, and refine their own knowledge through interactions with others would appeal to the brain's need for stimulation and challenge. When an individual is faced with circumstances that cannot be explained according to earlier beliefs he/she must work to create new patterns of understanding (Gurin, Nagda, & Lopez, 2004). By doing so new neural pathways can grow and develop into more sophisticated cognitive abilities.

A variety of constructivist teaching strategies can work well in the classroom. Brooks and Brooks (1999) list several guidelines that characterize constructivism. They are: seeking and respecting student perspectives; challenging student suppositions; relating new information to previously learned material; teaching big ideas, not discrete facts; and providing ongoing evaluation as part of the daily classroom experience. A number of specific assignments

reflect these tenets. Reflective journaling or reaction papers ask the students to examine their own belief systems. Short case analyses and role-playing require them to apply theoretical knowledge to actual situations (Oermann, 2004). Concept mapping gives them the opportunity to link new and old knowledge together in a graphic, three-dimensional way (Blanton, 2004). The use of video clips and literary passages adds relevance. Asking students to explain information through the use of analogy and metaphor stimulates novelty and creativity (Westwater & Wolfe, 2000). Using a variety of teacher and learner generated mnemonic devices stimulate "natural brain functions related to memory production and storage" (Koeckeritz, Hopkins, Merrill, 2004, p.79). A combination of many of these strategies will help keep students engaged in the learning process.

For the purposes of this study two strategies were chosen: jigsaw and concept mapping. Both activities take place within a cooperative learning group.

Jigsaw

A "jigsaw" activity incorporates both cooperative learning and constructivist tenets (Charania, Kausar, & Cassum, 2001). This process-oriented strategy requires that students learn together and then teach each other. It can be used to explore new material or review previously presented concepts. Groups can be evaluated as one unit, thereby placing the onus of interdependent responsibility on the group. A less stressful form of evaluation could be the use of games and competitions between groups over the material they have taught

each other. Smilkstein's fifth principle of human learning is: *"Emotions affect learning"* (2003, p. 73). A jigsaw asks students to be part of an interdependent team where each member is equally challenged to learn and teach. As they move toward a common goal they can develop a sense of camaraderie and belonging. This makes for a safe, non-threatening, yet challenging learning environment. Research suggests that the brain learns best when confronted with a balance between stress and comfort, in other words, high challenge and low threat (LeDoux, 1996). Caine and Caine (1994) call this a state of "*relaxed alertness*" (p. 70).

To conduct a jigsaw students are first divided into equal groups. For purposes of this study thirty six students will be divided into six groups of six students each. This is their "home group." Each group picks one of six different topics related to the learning unit. These topics will be specific diseases of the body system being studied. The groups are instructed to research and discuss the topic until each member feels comfortable with the content. In this study each group is to prepare a concept map to share with the rest of the class. After the six groups have completed their assignment the groups then re-configure into six new groups. One person from each concept map group is represented in the new groups of six. The new groups then move around the classroom to examine the six concept maps. Each team member teaches the rest of their group the content they specifically researched. In this study students learn together, create concept maps, and teach each other. Thus each student has an opportunity to learn with others, construct a visual map depicting the learning they have done

together, and then teach this information to others. Smilkstein's (2003) fourth principle of human learning states, "*Use it or lose it*" (p. 72). If a person stops doing something that he/she previously learned, the neural networks are pruned and some or all of the information may be lost. By teaching what one has recently learned the brain is more likely to make neural connections that are more resistant to pruning. The specific instructions given to the students in this study can be found in Appendix D.

Concept Mapping

A concept map is a two-dimensional visualization of the relationships between complex concepts. It is generally constructed around a central topic in the middle with spokes or branches to represent different aspects of the main theme. Concept maps can follow prescribed guidelines from the instructor or they can be free-flowing. Their advantage is that they are non-linear and provide an opportunity to graphically connect concepts as they occur to the creator. Concept maps have been used widely in nursing as a preparation tool for clinical rotations (Baugh, 1998; Fonteyn, 2007; Kathol, Geiger, & Hartig, 1998; Mueller, Johnston, & Bligh, 2001; Schuster, 2000). They have also been used as a lecture tool and an impetus for class discussion (Clayton, 2006).

Smilkstein's first principle of human learning is *"Dendrites, synapses, and neural networks grow only from what is already there" (p. 71).* Caine & Caine, (1994) point out that the brain seeks patterns in new information based on what it already understands. It reviews all the data previously known and formulates

new understandings for incoming data. The brain is designed to solve problems and seek answers. It organizes and categorizes new and old information into patterns that make sense to the individual. The use of concept mapping provides a structured classroom activity that would appeal to the brain's own need to construct pathways and relationships between new and already learned information.

The traditional nursing care plan which is generally displayed in five to six columns (assessment, diagnosis, goals, implementation, rationale, and evaluation) separates out each patient problem into its own row moving across the columns. This makes it difficult for the student to show relationships between any of the various component parts. As a result students do not always see the possible connections or understand why and how they are connected. Concept mapping is a shift away from this very concrete way of thinking about the individual parts of a problem. In concept maps, students are more likely to see the whole picture.

Concept mapping was developed in the 1960's by Joseph Novak (1984) of Cornell University and has its origins in constructivism. Jerome Bruner's (1987) mind mapping described how individuals move through the learning process. He found that learners were more successful if they were told to seek patterns in lists of objects rather than just memorize lists. This success increased when the learners were free to determine the patterns on their own.

A number of nursing studies have shown that concept mapping is a useful tool in helping students develop critical thinking skills. Wheeler and Collins

(2003) used a quasi-experimental study with a pretest / posttest design to determine if concept mapping improved the critical thinking skills of baccalaureate nursing students. They measured critical thinking with the California Critical Thinking Skills Test (CCST) and found a statistically significant difference in the mean gain scores in the experimental group. Hinck, et al., (2006) also used a quasi-experimental pretest / posttest study design to examine whether or not the use of concept maps assisted in care planning among nursing students in a psychiatric nursing rotation. Findings indicated that the student's ability to understand relationships in planning and evaluating nursing care significantly improved using the mapping technique. Students also expressed overall satisfaction with the teaching strategy.

Smilkstein's second principle of human learning is *"Dendrites, synapses, and neural networks grow for what is actively, personally, and specifically experienced and practiced"* (2003, p. 71). The use of group learning and contributing to the creation of a concept map would enable each student to be part of an active, personally relevant learning endeavor. Teaching others adds practice. Groups of students in the current study will be asked to graphically display via a concept map what they learn about the particular disease they are researching. They will then teach this to others.

Table 1 lists the teaching strategies chosen for this study. It outlines the theoretical principles behind the use of these strategies and reviews the research basis for their selection.

Table 1: Teaching Strategy Rationale

Teaching Strategy	Theoretical Principles	Research Support
Interactive Groups	Learning is Social - collegiality → ↓ threat - ↓ amygdala stimulation - ↓ fight or flight Active participation → ↑ Stimulation of basal ganglia & ↑ pleasure	Diamond Smilkstein Caine & Caine Given
Jigsaw	Non-threatening but challenging cognitive tasks → ↓ stress, ↓ cortisol, ↓ fight or flight, ↑ dopamine, ↑ pleasure → ↑ memory formation Group work	Environment of high challenge, low threat Given Sylwester Smilkstein Caine & Caine
Concept Maps	Construction of Knowledge Mind seeks for patterns Brain organizes & categorizes new information with old Basal ganglia stimulated when seeking own answers and associations → ↑ pleasure and ↑ memory formation	Bruner: Mind Maps Wheeler & Collins Hinck Caine & Caine Poldrack

It would be irresponsible at this point in time to claim that classroom environment and certain teaching strategies actually lead to the growth of new dendritic connections. Much more research is needed in this area. Radin (2005) interviewed ten leading educational theorists who believe strongly in the concept of creating classroom environments that enhance the brain's natural ability to learn. Nevertheless, even some members of this group were hesitant to state that there is a direct application of neuroscience research to the classroom.

Some of Radin's researchers felt that "neuroscience should be first linked to cognitive science, and cognitive science then linked to educational theory" (p. 85). As UCLA neuroscientist Willis (2007) points out most of the research done on the brain is not aimed at creating effective teaching strategies. Studies done in Willis's lab on glucose metabolism in the brain as a function of childhood growth periods were not intended to be used as educational guidelines. Nor is research examining the correlation between age and synaptic development meant to direct educational policy. Willis, like the theorists in Radin's study, believes that more research is needed before causal claims can be made. With this caveat in mind it behooves educators to become knowledgeable about the brain and to keep current on studies that will, hopefully clarify the link between brain activity and learning. This current study is designed to strengthen the link between what is known about the brain and how that can be interpreted from a cognitive learning perspective.

Second Degree Students

The participants of this study are divided into two cohorts. One cohort is made up of "traditional" nursing students and the other of "second degree" students. Since the two groups are not homogenous a review of the literature on the differences between these cohorts was conducted.

Second degree students are more likely to have families and full time jobs. They are generally highly motivated and focused (Bentley, 2006; Seldomridge & DiBartolo, 2005). Cangelosi & Whitt (2005) found that as a rule second degree

students are characterized by greater confidence, self-awareness, and maturity. Meyer, Hoover, & Maposa (2006) describe them as being highly focused on the completing their nursing education quickly and efficiently. Many have already outlined their future career pathways. They are eager to progress through school and return to the workforce. Second degree students may be impatient and demanding. They know what they want and they are willing to work hard to achieve their goals. Their focus is often on the end result and not on the process of getting there. If they come from a professional field that is characterized by clear cut parameters such as mathematics and engineering they prefer a straightforward approach to learning (Utley-Smith, Phillips, & Turner, 2007).

Nursing is a predominantly female profession. This historic trend remains true today. However, second degree programs tend to have a larger proportion of male students than do traditional programs (Toth, Dobratz, & Boni, 1998; Korvick, Wisener, Loftis, & Williamson, 2008). The mean age of second degree students has been reported to be between twenty-eight and forty (Howard-Ruben, 2002; Toth et al.) but Seldomridge & DiBartolo (2005) report that 74% have been out of school for five years or less. Korvick et al. did not find age to predict success in either traditional or second degree cohorts. Many studies found that second degree students have higher entering grade point averages and tend to academically out perform their traditional cohorts in nursing courses (Seldomridge & DiBartolo; Bentley, 2006). Almost all of the literature on second degree students comments on their academic maturity and ability to perform well in the classroom.

There are innumerable reasons why an individual may decide to pursue a nursing career. Employment opportunities abound in nursing. Generous salaries and benefits, job variety and portability, and the possibility of advancement make the profession very attractive. The desire to care for others and serve society drives others. Many second degree students have had a positive and meaningful experience with a nurse that cared for them or for a loved one at some point in their lives. Traditional students often share many of the same goals and experiences with their second degree colleagues. They may not always share the same degree of life experience. While differences do exist, once an individual starts the nursing curriculum he or she generally follows the same trajectory of coursework that the other nursing students in the program follow.

Conceptual Model

Figure 1 is a conceptual model for this study. In the top row is the overarching theoretical construct that brain-based teaching leads to the growth of dendrites, and hence new neural networks. The concepts that follow this assumption are that construcivist teaching pedagogy is brain-based teaching and that dendritic growth equals learning. Following this line of thought the use of specific constructivist strategies such as interactive group work, jigsaw activities and concept mapping would lead to and could be measured by an improvement in examination scores. If the exams are designed to test the acquisition of higher order cognitive learning it would follow that the use of a brain-based teaching methodology would lead to higher-order cognitive learning. Student perceptions

of the experience are important because challenge without threat (Caine & Caine, 1994) and joy in learning trigger both pleasure centers and the development of long term memory pathways (Pekrun, Goetz, Titz, & Perry, 2002; Gunn, Richburg, & Smilkstein, 2007).

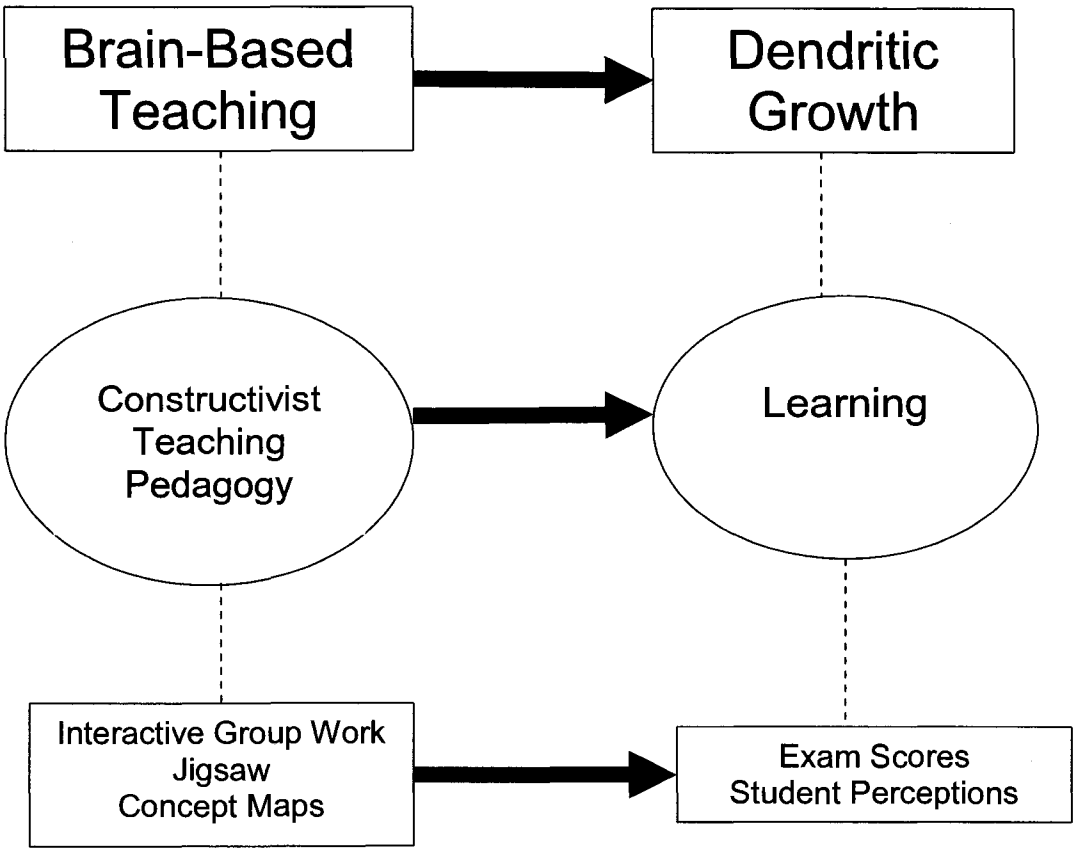


Figure 1: Constructs – Concepts – Strategies

CHAPTER THREE

METHODS

Overview of Chapter Three

The primary purpose of this study was to compare the impact of brain-based constructivist teaching strategies versus a traditional lecture format on the acquisition of higher order cognition and learning as determined by test scores. A second purpose was to elicit student feedback regarding their feelings about the two teaching approaches. The first section of this chapter presents an overview of the research design with a description of the independent and dependent variables. The next section describes the participants. Section three outlines the procedure and the methods of data collection. The final section describes the type of quantitative and qualitative measures used.

Research Approach

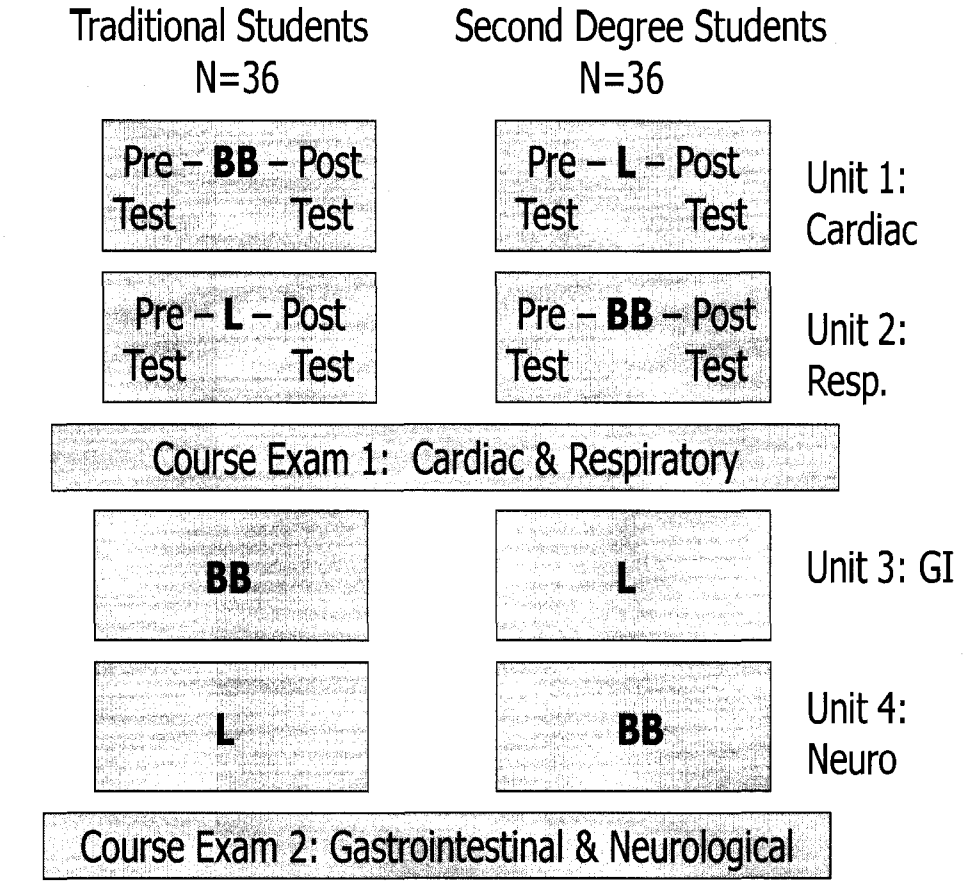
This was a quasi-experimental quantitative mixed design research study. The first phase was a quantitative study using a Factorial Analysis Design with a between and within groups' comparison. There were three independent variables and two dependent variables. Each independent variable had two levels. Thus, this was 2 x 2 x 2 factorial research design with repeated measures on the last factor (Gliner & Morgan, 2000).

The first independent variable was teaching strategy. One strategy was a straight lecture format; the other was a combination of constructivist learning activities, specifically an interactive jigsaw group activity and concept mapping.

The second independent variable was type of student. One group was made up of 36 "traditional" nursing students and the other group was made up of 36 "second-degree" students. The third independent variable was a within group pre-test / post-test change over time. One dependent variable was post-test minus pre-test gain scores and/or variance. The second dependent variable was a comparison of mean scores on course exams One and Two that have been tested over the last four years for face validity and reliability. A between and within groups comparison was conducted on each of these dependent variables. Figure 2 displays the design variables.

The second phase of the study was an analysis of how the students felt about the two types of teaching strategies using a basic interpretive qualitative approach. The two classes were asked a series of questions via the discussion board of their course on-line Blackboard Shell. Analysis of student responses involved seeking out common themes. The questions asked follow:

1. Did you enjoy working in groups on the concept maps? Why or why not?
2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.
3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?
4. Did you prefer straight lecture or group work and why?
5. Do you have any additional comments you'd like to add?



IV^1 = Teaching Format
Brain based teaching (BB)
Lecture (L)

IV^2 = Type of Student
Traditional
2nd Degree

IV^3= Pre-test / Post-test change over time
Within group

DV^1 = Gain Scores = Post-test minus Pre-test and/or covariance between groups

DV^2 = Course Exam Scores within and between groups
Course Exam 1: Cardiac & Respiratory
Course Exam 2: Gastrointestinal & Neurological

Figure 2: Independent Variables in a 2 x 2 x 2 Factorial Analysis Design with Repeated Measures on the Second Factor

Participants

The participants were students enrolled in a medical-surgical nursing course in a four year baccalaureate nursing program. There were two separate groups of students (n = 36; n=36) each covering the same material at distinctly separate times. One group was composed of "traditional" nursing students and the members of the other "second-degree" group of students all had baccalaureate degrees in a variety of non-nursing fields. This was a convenience sample and participants were already assigned to one of the two experimental groups by nature of their enrollment status.

Acceptance into the school of nursing is a highly competitive process. Students enrolled in the traditional course enter the program as college juniors or higher. At the time they participated in this study they were classified as seniors. Only one-third of the total applicant pool was accepted into the seventy-two slots available when these students applied. Their acceptance was based on an overall grade point average (GPA) of at least 2.5 on a scale of 4.0 as well as submitted essays and the completion of all pre-requisite courses. The reality of this process is that no one below a 3.0 GPA was considered. The average GPA for this class is 3.85 after a minimum of two years of university matriculation. They were a very high-achieving, competitive group of students. The second degree students must meet the same basic requirements as the traditional cohort. They, however, go through an interview process with the hospitals that sponsor their program. If selected they sign a contract with the sponsoring hospital that stipulates that they will work for that hospital in a full time capacity

for two years following graduation. In exchange the hospital pays for one-half of the student's tuition and fees. The majority of the students in both cohorts worked outside of school and many of them were juggling family responsibilities. The average entering GPA for the second degree cohort was 3.3 out of 4.0. Only the most current 45 credits are included in determining this value.

The students' identities on the pre-test post-tests were protected via the use of a six digit individual coded identifier that they were asked to use for all four of these tests. This identifier consisted of the participant's month of birth, last two digits of his/her social security number, and the last two digits of his/her home phone number. These tests were not be used towards the students' class grades. To ensure privacy a nursing faculty member that was not associated in any way with the courses kept a list of students and their identifiers. The scores on the course examinations, however, were part of their course grade. Therefore, only group means were be utilized in the data analysis of the two course examinations. An Institutional Review Board (IRB) Application for Exempt or Expedited IRB Review status was approved at both the University of Northern Colorado and at Colorado State University. This formwas appropriate for the purposes of this study because "the participants are adults, data will be collected in a normal educational setting, the data are not sensitive in nature and accidental disclosure would not place the participants at risk, and no identifiers will link individuals to their responses" (IRB guidelines, University of Northern Colorado). As part of the IRB process all students were asked to sign a consent

form with their privacy protection rights clearly described. IRB approval letters from both institutions are included in Appendices A and B.

A Note About Medical-Surgical Nursing

An enormous amount of content is covered in a medical-surgical course. In fact this content is often thought of as the heart of a nursing school curriculum because the vast majority of nurses are employed in medical-surgical nursing in one setting or another. In addition, the bulk of the National Council Licensure Examination for Registered Nurses (NCLEX-RN) tests medical-surgical content. In order to practice nursing a graduate must successfully pass this examination. Medical surgical nurses care for patients across the age spectrum, from adolescence to old age. Medical-surgical nurses work in hospitals, clinics, home care, the military, and in rehabilitation centers. They interface with individuals in all phases of life, and in all phases of health and disease. They must be prepared to care for adult individuals with diseases and surgeries in every body system. A number of studies have found that the grade point average in the medical surgical course of a nursing curriculum is an accurate predictor of success on the NCLEX examination (Heupel, 1994; McKinney, Small, O'Dell, & Coonrod, 1988; Waterhous, Carroll, & Beeman, 1993).

Procedure

Data Collection

There were four separate learning units that were be used for this study:

Unit 1: Care of Clients with Cardiac Disorders (12 contact hours)

Unit 2: Care of Clients with Respiratory Disorders (7 contact hours)

Unit 3: Care of Clients with Gastrointestinal Disorders (7 contact hours)

Unit 4: Care of Clients with Neurological Disorders (12 contact hours)

These units were chosen for two reasons. First, there are two long and two medium long units of study of equal contact time and second, the matched units are of equal difficulty in terms of reading material and content. Given the matched nature of these learning units it did not seem necessary to add them as a fourth independent variable.

In each class, two of these units were taught using a traditional lecture format and the other two units were taught using "brain-based" strategies. The units being taught using lecture format for one class were taught using the brain-based approach for the other class. The units being presented in lecture format were presented with power point slides by the instructor. Appendix C contains the lecture schedule for the two cohorts. This instructor has been teaching this content for ten years and is quite comfortable and consistent in its presentation. The power point lectures and examinations were all prepared by the instructor over the last four to six years. Constructivist jigsaw activities utilizing concept maps and cooperative learning teams formed the basis of the brain-based teaching strategies. Appendix D is a copy of the instructions given to the students as they prepared for these activities.

Instrumentation

The first two units began with a 20 item pre-test over the material to be covered. Upon completion of the learning units each student completed the same test as a post-test. Gain scores from post-tests over pre-tests were used to detect differences in learning based upon the type of instruction provided. Both a within group and between group analysis was done on these scores. The third and fourth units did not utilize pre and post tests to control for pre-testing effects. Pre-test and post-test exams were not used as part of the participant's course grade. After the first two learning units the students took Course Exam 1: Cardiac and Respiratory Disorders. After the last two units Course Exam 2: Neurological and Gastrointestinal Disorders was administered. The items covering each learning unit were separated out of the course exams for analysis. In other words questions covering the cardiac content were separated from the respiratory questions and questions covering the neurological content were separated from questions over the gastrointestinal unit. This, in essence, created four separate sets of data. Only the mean score on these data sets for each of the two cohorts was used for analysis. Thus, even though Course Examinations 1 and 2 are part of the student's grade, the mean scores from the four data sets used for this study had no impact on course grades. The Course Examinations have been used for the past 5 years and have been computer analyzed after each use for face validity and reliability using a point biserial items analysis and a Kuder-Richardson 20 (K-R 20) analysis. Only questions with positive point biserial numbers on previous exams were used. Point biserials on

test items have averaged between 0.2 – 0.6 with the majority at 0.25 and greater. The questions were taken from test banks that accompany the text book used in the class. Only items that are ranked by the test bank creators at the higher cognitive levels of application, analysis, synthesis, and evaluation were used. K-R 20 scores on both Course Examinations have averaged 0.63 with a range of 0.5 – 0.8 over the last four years. While this would be considered a weak K-R 20 score in most university courses, for nursing courses where most students perform well, a K-R 20 greater that 0.5 is considered adequate to good. The test results during that time have been amazingly consistent. The range of scores on any examination given in Nursing 385 and Nursing 386 is traditionally 70 – 95 out of 100. There is the occasional outlier at either end. The grades fall into a normal bell curve with the majority of grades falling between 80 – 90 percentage points. It is more likely to have an occasional negatively skewed bell curve as students are more likely to fall below 70% than above 95%. In order to pass the course students must have an examination average of 70%.

At the end of the fourth and final learning unit the students in each class were given the opportunity to take part in a class discussion to explore their feelings about the two teaching strategies. All students were invited to participate in these discussions but participation was optional. The discussions took place on the Discussion Board of their course on-line Blackboard Shell. The consent form for the study included the discussion portion.

A map of the data collection schedule is outlined in Table 2.

Table 2: Data Collection Map

Unit 1	Pre-Test	Intervention or Lecture	Post-Test
Unit 2	Pre-Test	Intervention or Lecture	Post-Test
Course Examination 1: Cardiac & Respiratory			
Unit 3		Intervention or Lecture	
Unit 4		Intervention or Lecture	
Course Examination 2: Neurological & Gastrointestinal			
During the last two weeks of the course: Qualitative Data Collection Qualitative Data Analysis was done after final course grades are submitted			

Statistical Analysis

Quantitative data analysis will be carried out using *t*-tests, a 2 x 2 factorial ANOVA with repeated measures on the second factor, and a One-Way ANOVA with the appropriate Post Hoc Test. If data are skewed the appropriate non-parametric (Kruskal Wallace) will be used.

CHAPTER FOUR:

RESULTS

Introduction

The purpose of this quasi-experimental quantitative mixed design study was to compare the effectiveness of brain-based teaching strategies versus a traditional lecture format in the acquisition of higher order cognition as determined by test scores. A second purpose was to elicit student feedback that describes their feelings about the two teaching approaches. This chapter presents an analysis of the data.

Description of the Participants

A convenience sample of baccalaureate students enrolled in medical-surgical nursing during the spring 2008 semester at a northern Colorado university was used. Students enter the school of nursing after completing a substantial number of pre-requisites and the majority of their non-major courses. The traditional students therefore enter the nursing program in their junior year, at the earliest. The second degree students are eligible to enter the program upon completion of their prerequisites. Participants were enrolled in two separate sections of the same course. At the beginning of the study, one cohort consisted of 36 traditional students and the second cohort consisted of 36 second degree students. Due to three failures and one withdrawal by the completion of the study the numbers were 33 and 35 respectively. Data from students unable to complete the course was excluded from the data analysis.

There were three men in the traditional cohort and four men in the second degree cohort. The average age of the traditional cohort was 24 and the average age of the second degree cohort was 30.34. The average entering GPA for the traditional cohort was 3.7 and for the second degree students 3.3 on a 4.0 scale. All students in the second degree cohort and two of the traditional students had baccalaureates in a field other than nursing. Table 3 depicts the demographic data. Figure 3 graphically displays the comparison of ages between the cohorts.

Table 3: Participant Demographic Data

Participant Group	Starting N	Ending N	Gender	Average Age And Range	Previous Baccalaureate	Entering GPA
Traditional	36	33	F = 33 M = 3	22.70 21 - 41	2	3.85
Second Degree	36	35	F = 32 M = 4	30.34 21 - 51	36	3.3

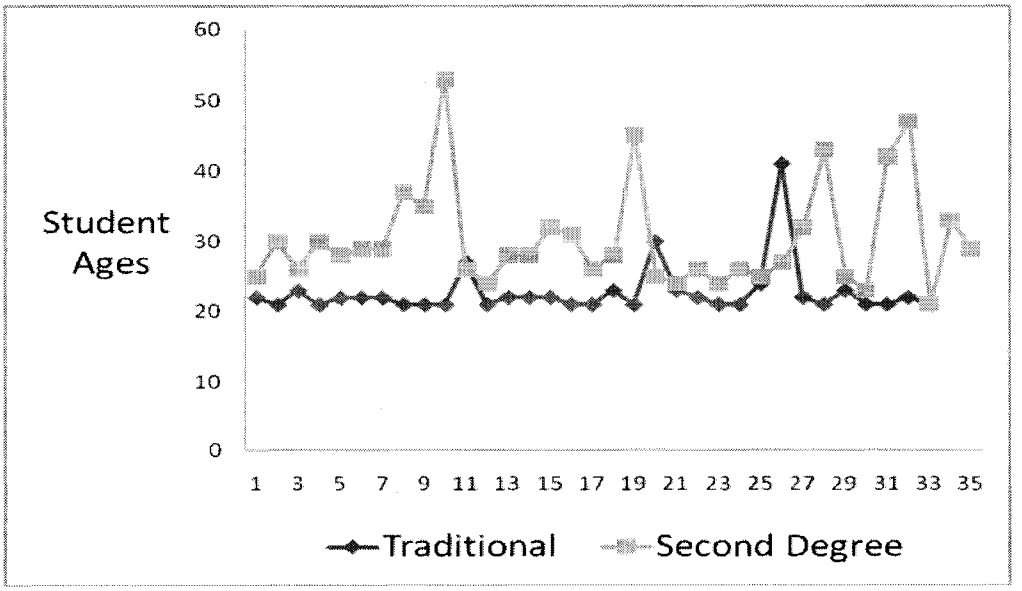


Figure 3: Comparison of Ages by Cohort

Data Collection

Four learning units were used for the quantitative portion of this study: disorders of the cardiac, respiratory, gastrointestinal, and neurological systems. Pre-tests and post-tests were given for the cardiac and respiratory units. A statistical analysis was done on the within and between group gain scores. There were also two unit exams that were used for analysis. One of these was given following the cardiac and respiratory units and the other was given following the gastrointestinal and neurological units. Two learning units were presented via straight lecture and two units were presented using brain based interactive teaching strategies. The presentation style was reversed for the two classes.

Instruments

The cardiac and respiratory units each started with 20 item pre-tests. The same tests were administered immediately following completion of the learning unit. These tests had been piloted during the previous semester and analyzed for face validity and reliability using a point biserial items analysis and a Kuder-Richardson 20 (K-R 20) analysis. Point-biserials on the pilot cardiac exam ranged from -0.12 to 0.43 with a K-R 20 of 0.501. While this would be considered a weak K-R 20 score in most university courses, for nursing courses where most students perform well, a K-R 20 greater that 0.5 is considered adequate to good. Point-biserials on the pilot respiratory exam ranged from -0.11 to 0.60 with a K-R 20 of 0.445.

Course examinations covering the learning units were administered from two to four weeks after the completion of that unit. The delay was due to the fact that more than one learning unit is included in each of the course examinations. Normally only two to three weeks occurs between a learning unit and the course examination. The four week span of time was due to spring break falling in the middle of a learning unit. The course examinations have been used for the past 5 years and have been computer analyzed after each use for face validity and reliability using a point biserial items analysis and a Kuder-Richardson 20 analysis. Only questions with positive point biserial numbers on previous exams were used for this study. In the past, point biserials on test items selected for re-use have averaged between 0.2 – 0.6 with the majority at 0.25 and greater. The questions were taken from a test bank that accompanies the text book used in the class. Only items that are ranked by the test bank creators at the higher cognitive levels of application, analysis, synthesis, and evaluation were used. K-R 20 scores on both Course Examinations have averaged 0.63 with a range of 0.5 – 0.8 over the last four years. The test results during that time have been amazingly consistent. The range of scores on any examination given in medical surgical nursing is traditionally 70 – 95 out of 100. There is the occasional outlier at either end. The grades fall into a normal bell curve with the majority of grades falling between 80 – 90 percentage points. It is more likely to have an occasional negatively skewed bell curve as students are more likely to fall below 70% than above 95%.

Data Analysis

The quantitative research question was divided into four sub-questions. The first of these compares pre-test, post-test gain scores between groups and the second to a within-groups change over time on the pre-test, post-test scores. The last two sub-questions relate to course examination scores: Is there a difference in scores related to type of student or type of teaching method? Data analysis of the quantitative question will be described first. Individual sub-questions will be dealt with separately.

> Quantitative Research Question:
> Is there a difference in test performance when students are taught according to constructivist teaching strategies versus a traditional lecture format?
>
> A. Is there a difference in post-test over pre-test gain scores related to type of student or type of teaching method?

Pre-tests and post-tests were given on only the first two learning units: cardiac and respiratory. A lecture format was used in the traditional cohort for the respiratory unit and brain based activities as described in Chapter Three were used for the cardiac unit. In the second degree class the teaching method was reversed. The K-R 20 scores on the post-tests ranged from 0.403 to 0.504.

The Statistical Package for the Social Sciences (SPSS 16.0) was used for all data analysis. An independent samples *t*-test was used to compare gain scores between the cohorts. This test was chosen because there were two experimental conditions and different subjects were assigned to each condition. Levene's Test for Equality of Variances indicated that equal variances could be assumed on both gain score sets of data. At an alpha level of 0.05 there was no

statistically significant difference between the cardiac gain scores of the two cohorts (t = .246, df = 56, p = .807) or for the respiratory gain scores (t = 1.461, df = 54, p = .150). Tables 4 and 5 depict these results.

Table 4: Descriptive Statistics on Post Test over Pre Test Gain Scores

Test	N	Min	Max	Mean	Std. Deviation	Skewness Stat.	Skewness Std.Error
Cardiac Gain Score	58	-2	9	3.07	2.191	.199	.314
Respiratory Gain Score	56	0	8	3.45	2.044	.371	.319

Table 5: Results of Independent Samples t-test on Gain Scores

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	T	df	Sig (2-tailed)
Cardiac Gain Score	.353	.555	.246	56	.807
Resp. Gain Score	.835	.365	1.461	54	.150

Table 6 depicts the overall descriptive statistics on the pre-tests and post-tests for the combined cohorts. Fifty-eight of the sixty-eight eligible students completed both the pre-test and the post-test on the cardiac unit and 56 of the 68 students successfully completed both the respiratory pre- test and post-test. Data from students who did not complete both the pre-test and post-test were eliminated. There were two tests that did not contain the personal identifying code and could therefore not be included in the data set. Table 7 depicts the

statistics separated into the type of student. The teaching strategy used for that unit is indicated in the "Type of Student" column.

Table 6: Descriptive Statistics on Pre-Test / Post-Test Data

Test	N	Min	Max	Mean	Std. Deviation	Skewness Stat.	Skewness Std.Error
Cardiac pre-test	58	6.00	19.00	12.6724	2.28180	-.277	.314
Cardiac post-test	58	9.00	20.00	15.7414	2.45350	-.804	.314
Resp. pre-test	56	6.00	17.00	12.2321	2.72357	-.534	.319
Resp. Post-test	56	10.00	19.00	15.6786	2.08986	-.782	.319

Table 7: Cohort Group Statistics

Exam	Type of Student	N	Mean	Mean Gain	Std. Deviation	Std. Error Mean
Cardiac pre-test	Traditional BB	28	12.5714		2.04448	.38637
	2nd Degree L	30	12.7667		2.51456	.45909
Cardiac post-test	Traditional BB	28	15.7143	3.14	2.62265	.49563
	2nd Degree L	30	15.7667	3.0	2.32947	.42530
Resp. pre-test	Traditional L	29	11.2414		2.64109	.49044
	2nd Degree BB	27	13.2963		2.43081	.46781
Resp. Post-test	Traditional L	29	15.0690	3.83	2.15359	.39991
	2nd Degree BB	27	16.3333	3.04	1.83973	.35406

BB = Brain Based L = Lecture

Each students total gain score on the two sets of pre- and post tests was determined. A Univariate Analysis of Variance was used to compare total gain scores by type of student. Table 8 displays the descriptive statistics on this data set. There was no statistical difference on total gain scores based on type of student (F = 1.949, df = 1, p = .168).

Table 8: Descriptive Statistics on Total Gain Scores by Student Type

Type Student	Mean Gain Score	Std. Deviation	N
Traditional	6.86	3.314	29
Second Degree	6.29	3.130	59

To determine whether there was any difference in gain scores based on teaching method, regardless of cohort, gain scores from the units taught via lecture were compared to gain scores from the units taught using brain-based methods. Table 9 depicts the combination of scores for this analysis.

Table 9: Combination of Units for Data Analysis of Research Question A

	Gain Scores Lecture Units	Gain Scores Brain Based Units
Traditional Cohort	Respiratory	Cardiac
Second Degree Cohort	Cardiac	Respiratory

Results of an independent samples t-test demonstrated no statistical significance. Equal variances were assumed (F = .649, p = .422). There was no

statistically significant difference in gain scores based on teaching method (t = .794, df = 112, p = .429).

The second part of research question one analyzed a within-groups change over time on the pre- and post- tests related to teaching method.

B. Is there a difference in within-groups change over time related to type of teaching method?

A combined between and within groups analysis was done using a 2 x 2 factorial ANOVA with repeated measures on the second factor. On both the cardiac and respiratory units there were statistically significant findings to demonstrate change over time. The results on the cardiac pre-test post-test within group change over time were F (1,56) = 112, p < .001 with a large effect represented by an *eta* = .82. The respiratory pre-test post-test within group change over time were similarly significant: F (1,54) = 161, p < .001 with a large effect size of *eta* = .87. Pre-tests and post-tests were used on the first two learning units only. The traditional students had straight lecture for the respiratory unit and engaged in brain based activities for the cardiac unit. This was reversed for the second degree students. Both groups demonstrated statistically significant change over time regardless of teaching method.

The third part of research question one examined the difference in scores on unit examinations between cohorts.

C. Is there a difference between course examination scores related to type of student?

Each of the two course examinations contained questions on two of the learning units used in this study. Questions on each unit were separated out so that for

each cohort there were four sets of data. These four sets of data were not equal in number. There were 31 questions on the cardiac unit, 15 on the respiratory unit, 29 on the gastrointestinal unit, and 45 on the neurological unit. The K-R 20 on these exams ranged from .591 to .724. As mentioned earlier these would indicate reasonable reliability on an examination given in this nursing program where the range of scores tends to be fairly narrow and all students do relatively well on examinations. Thus there is less discrimination than one might expect on an exam given to a more heterogenous population.

To determine if there was any difference between cohorts a percentage score of items answered correctly on each exam was determined for each student. The percent of items answered correctly on the four units for the traditional cohort was then compared with the percent of items answered correctly on the four units for the second degree cohort. An independent samples *t*-test was used to compare percent of correct answers by type of student. Descriptive statistics are depicted in Table 10.

Table 10: Percent Correct on All Examinations

N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
					Statistic	Std. Error
272	40%	100%	81.1103	10.68791	-.766	.148

Equality of variances was assumed (F = .613, p = .435). There was no statistically significant difference in the percent of correct answers based on type

of student (t = .742, df = 270, p = .459). Since there was no statistical difference on the percent of correct examination answers based on type of student this independent variable was excluded from further data analysis.

The fourth part of research question one examined the difference in scores on unit examinations based on teaching strategy.

D. Is there a difference between course examination scores related to type of teaching method?

In order to answer this question the percent of correct answers from exams given on lecture units was compared to the percent of correct answers from exams given on brain-based unit. In other words, percent correct scores from the two units in each cohort that were taught via lecture were combined and compared with the percent correct scores of the two units from each cohort that were taught via brain based activities. Table 11 depicts this approach.

Table 11: Combination of Units for Data Analysis of Research Question C

	% Correct Answers on Examinations Lecture Units	% Correct Answers on Examinations Brain Based Units
Traditional Cohort	Respiratory Neurological	Cardiac Gastrointestinal
Second Degree Cohort	Cardiac Gastrointestinal	Respiratory Neurological

An independent samples t-test was used to analyze this data. Descriptive statistics are the same as those shown in Table 9 above. Table 12 displays the group statistics for this t-test.

Table 12: Group Statistics for % Correct Answers by Teaching Method

Teaching Method	N	Mean	Std. Deviation	Std. Error Mean
Lecture	136	79.772059	11.2861547	.9677798
Brain Based	136	82.448529	9.9158084	.8502736

Variances were assumed to be equal however there was marginal significance in the Levene's test (F = 3.270, p = .072) indicating that the groups may not have been equal. There was a statistically significant difference in the percent of correct answers based on teaching method (t = -2.078, df = 270, p = .039). The p value remained consistent at .039 regardless of whether equal variances were assumed or not assumed. Students taught using brain-based methods had higher percent averages on their exams than they did when they were taught using a straight lecture format. The effect size was small with d = .25.

Further analysis was conducted on the individual examination scores. A One-Way ANOVA was used to compare examination scores by teaching method. The descriptive statistics are shown in Table 13.

Table 13: Unit Examination Scores by Teaching Method

Exam Scores	Teaching Method	N	Mean	Std. Deviation	Std. Error Mean
Cardiac	Lecture	35	25.3286	3.3539	.5669
(31 poss.)	Brain Based	33	26.6970	2.3682	.4123
Resp.	Lecture	35	11.9697	1.9282	.3357
(15 poss.)	Brain Based	33	11.8000	1.9823	.3351
GI	Lecture	35	23.2286	3.1068	.5252
(29 poss.)	Brain Based	33	24.1515	2.7171	.4730
Neuro	Lecture	35	34.7576	4.8414	.8428
(45 poss.)	Brain Based	33	36.9143	3.0426	.5143

In all cases skewness was within acceptable limits ranging from -0.412 to - 0.860. A One-Way ANOVA was used to analyze the data on all four subject examinations. This test was chosen because there is only one independent variable, teaching method, but there were multiple dependent variables: percentage scores on four exams for each of the two groups. Type of student was eliminated as a variable and teaching method was shown to be the only statistically significant variable in analyzing test scores. Since it was not clear at the onset of this study which teaching method would lead to higher test scores a two-tailed analysis was appropriate. As before, SPSS 16.0 was used to conduct the ANOVA. Equality of variances was questionable on the cardiac scores with a marginal significance ($F = 3.363$, $df = 66$, $p = .071$). ANOVA results were the same in terms of significance on the cardiac exam ($F = 3.736$, $p = .058$). The p remained consistent at .058 whether or not variances were assumed. There was a medium effect size of $d = .47$. ANOVA results on the neurological test scores were statistically significant. Equality of variances could not be assumed ($F = 8.692$, $df = 66$, $p = .004$) and the results were significant ($F = 4.897$, $p = .030$)

with a medium to large effect size of $d = .55$. While neither the respiratory unit nor the gastrointestinal unit had statistically significant differences based on teaching strategy the effect sizes were small to medium ($d = .37$ on the respiratory unit and $d = .31$ on the gastrointestinal unit). The respiratory unit was the only unit in which the mean scores of the lecture group were higher than the mean scores of the brain-based group. Table 14 summarizes these results.

Table 14: One-Way ANOVA Comparing Examination Score by Teaching Method

Exam	*F*	df	p	*d*
Cardiac	3.736	66	.058	.47
Respiratory	.128	66	.722	.37
Gastrointestinal	1.692	66	.198	.31
Neurological	4.897	66	.030	.55

Summary of Quantitative Data Analysis

Part one of the quantitative research question asked if there was a difference between the gain scores of post-test over pre-test results on the cardiac and respiratory units based on teaching method. There was no statistical difference on gain scores found. Part two of the research question examined the within group change over time on the gain scores of post-tests minus pre-tests. There was a significant difference in gain scores for both units in both cohorts. Part three of the research question asked if there was a difference in unit examination scores based on type of student and again the answer was no. As a

result type of student was removed as an independent variable in further data analysis. Part three of the research question asked if there was a difference in unit examination scores based on teaching strategy and the answer was yes. The two longest units with the greatest number of examination questions showed either statistically marginal or statistically significant results based on teaching strategy with scores on brain based units having higher means than scores on lecture units. The shorter units with fewer examination items showed no statistical significance regardless of teaching method. When percent of correct examination scores for each student were compared according to teaching strategy there was a statistically significant finding with percent of correct answers mean scores being higher on the units taught using brain based strategies versus straight lecture. The implications of these findings will be discussed in Chapter 5.

Analysis of On-Line Class Responses

During the final two weeks of the semester students were asked to answer a number of questions on the discussion board section of their on-line Blackboard course shell. This was a voluntary activity and participation was not part of their course grade. The researcher did not access these responses until after all course grades had been submitted. The questions were:

1. Did you enjoy working in groups on the concept maps? Why or why not?
2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please

elaborate on what was helpful and what was not helpful about this experience in terms of learning.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?
4. Did you prefer straight lecture or group work?
5. Do you have any additional comments you'd like to add?

The responses were printed out and randomly sorted within each cohort; however, each response was kept within its cohort. Thus, differences between student types could be analyzed. A number of themes emerged from this data. These themes were deduced by reading the responses and grouping them accordingly. These will be described in the following sections. Qualitative data analysis was purely descriptive in nature. There was no separate independent expert reading by another researcher so there was no triangulation of analysts. The on-line responses, separated by cohort, are included in Appendices F and G.

Question One

> Did you enjoy working in groups on the concept maps? Why or why not?

Four major positive and three major negative themes emerged from the discussion about whether or not the students enjoyed working on concept maps as a learning strategy. These themes were consistently found in both cohorts.

Positive Responses

1. The majority of students felt that it was helpful to learn from each other because other members of their group had different perspectives,

experiences, and sometimes a better understanding of the material being researched. This, in turn, allowed them to "pool together our knowledge and understanding of the topic."

The following responses were typical.

> "...someone in the group may have understood the concept in a way that could make it easier for someone else to understand. It's always nice to have other people's perspectives as well."
>
> "It was a great opportunity to interact and learn from each other. I was able to learn a few things from their knowledge."
>
> "Some folks had interesting stories or different ways of remembering information that was helpful."
>
> "Others may have a better understanding of the topic than myself and they can shed some light on the subject for me."

2. Students perceived working on concept maps as being an active way of learning. By engaging in a number of activities as they researched, created their concept maps, and then prepared to teach others it helped them focus. It also allowed them an opportunity to construct their own understandings. As one student pointed out "I really learned a lot from picking apart a disorder and filling out the concept map." Others had similar experiences.

> "Working on the concept maps allowed us to actively engage with each other by discussing the subject matter, teaching each other, and helping each other to better understand the material. Making the concept maps helped us to organize, prioritize, and pick out the important information."
>
> "We were challenged to read and understand the information and then interpret it and re-create it. This really helped me learn about the subject because I was actively engaged. "

"I felt that it was helpful to sort through all the unnecessary information and pick out what is important and then organize it in a succinct fashion on the map."

3. There were two students who stated that they were visual learners so that creating the concept map enhanced their learning. One stated that "The concept maps helped me get the holistic view of a topic, and also helped me see connections that I might not see just hearing or reading about it." The other stated that "...if there were pictures of how things went I retained it better...in the heart failure poster there were arrows showing the back flow of the heart into the respective organs, and I remember that very well."
4. Two students liked the creative nature of concept mapping. One pointed out: "I really enjoyed working on the concept maps because it allowed us to use our creative side."

Negative Responses

1. Students, and groups, could become distracted and therefore not stay on task. One student explained: "It seems as though when you put a group of students together to complete a project, people are easily distracted from what they are supposed to be doing." Another reflected that "our group was not always on task and chatted a lot."
2. Students do not always contribute equally. As one student pointed out: "It seems to me that in every group there are always a couple of people who end up doing all the work."

3. Several students felt that the activity would have gone more smoothly if they had been given the assignment earlier so that they could have come to class prepared to create their concept maps. They expressed some frustration at having to do all the research as well as create the map in space of one class period.

Question Two

> Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

Overall students in both classes expressed enjoyment working in groups because they liked the variety and the active participation component of group work, but most of them expressed frustration over the teaching abilities of their classmates. They pointed out that the fact that they had an opportunity, and responsibility, to teach others helped them understand their own content area better. Three major themes emerged.

1. Students felt that they really learned, understood, and retained the topic they researched, depicted in the concept map and taught others.

One student in particular was able to sum up the feelings of most of the respondents.

> "I felt that working on the concept maps and then teaching each other the content helped us learn the material better because it incorporated many forms of learning. We had to read the book to get the information, then we rewrote the information on the poster in a simpler form, and then we taught each other. I felt like I got the information reinforced three different times. I also like that we taught each other in smaller groups. This is less intimidating than teaching the information to the whole class. I found every aspect of this activity to be helpful to my learning of the material."

Another student stated that "whatever subject you teach others really stays with you." Along the same lines her classmate observed that: "I feel that when I explain something out loud, I better understand it myself." This was seconded by a student who stated:

> "I definitely felt that teaching each other the material helped me learn it better. It was helpful because by playing an active role in creating my concept map with my group, I learned the information, and then by teaching it to others, it helped reinforce those concepts."

2. Students enjoyed the variety and active aspect of learning and teaching together versus sitting in a lecture all the time.

Many of the students enjoyed the variety of working in groups and moving around the room to teach each other. It broke up the four hour class period. As one student pointed out: "I do like having variation in the day and having the opportunity to walk around and talk with people was nice." Another stated that it was a "fun environment making it a better learning experience for me." Many students pointed out that the activity kept them "awake and engaged."

3. While students enjoyed their part of the experience thy expressed frustration about their classmates inability to teach effectively.

Many students pointed out that their classmates were not always able to explain their concept maps very effectively. As one student mentioned "some people are better teachers than others." Another stated that she "had difficulty really understanding the way other students tried to present the information." Part of the problem was identified by a student who felt that "the other students do not speak with a great amount of confidence or credibility...many times I couldn't really tell what was important for me to retain." Another student echoed that

concern "...others add their own input without, maybe, knowing the whole truth which gets confusing." One student was able to articulate the overall reaction quite well:

> "I definitely felt that teaching each other the material helped me learn better. It was helpful because by playing an active role in creating my concept map with my group, I learned the information, and then by teaching the information to others, it helped reinforce those concepts. What wasn't helpful about this experience was when others would just simply read off their posters and not add much. It made me feel as though it was a waste of time teaching, as I could easily go through and read the posters myself."

One student summed up the teaching experience well: "It helped me retain my topic better, but NOT everyone else's."

Question Three

> What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

Responses to question three basically reiterated much of what had already been stated in question two. There were five main themes that emerged. More than half of the students felt that they really learned their assigned topic well but had more difficulty with topics that were presented by their colleagues. The reasons for this were very much in accord with answers to questions number one and two and revolve around the major theme: active participation enhanced student learning. There were both positive and negative feelings about lecture versus the constructivist strategies.

1. Active participation enhanced student learning in both group work and lecture.

One student observed that he/she "learned in small groups because of how much I was able to participate." Another stated that "I always felt ready for the exams on the subjects that I actually researched for the group work." Another student reflected that working in the groups and then teaching the material to others allowed her to review the material several times in different ways stating that "learning from multiple forms helped me review the overall concept of different topics. The more times I reviewed the material, the better!" One student stated that sitting in a lecture setting made it difficult to retain information. On the other hand she "learned better when making the concept maps and working with others because we discussed the material and created a visual learning too. I feel I learn better when I am doing something, be it discussing or drawing a diagram." Even while sitting in a straight lecture students pointed out that they learned and retained the information better when they were active participants. One reflected that "If there is a lot of discussion and class participation I will retain the information a lot better than if I just sit and listen and don't participate." This student enjoyed the group work because "I learned in small groups because of how much I was able to participate." Another student found that they learned well from listening to lectures when they chose "to take a more active part in my education by answering and asking questions."

2. The responsibility to teach forced the students to learn their assigned material more completely. This aided them in retaining details about their own topic.

One student pointed out that "you are really excited about the subjects you teach and that really helps me want to learn the subject." Another summed it up well by stating: "Having to learn the information for myself and then explaining it to other students helped me better learn the material. It seems that added responsibility of having to teach others really pushes people to completely understand concepts."

3. The combination of lecture and group work added variety to a long class period and the variety, itself, aided in learning.

One student observed that they liked participating in the group work because it "...helped me retain the information for the exams. But having lecture helped me grasp the concepts as well. I think it was most useful to have the day broken up into group work and lecture." Another student humorously pointed out that "group work is always a great way to change things when class has ptosis!" Another student added that even if the lectures were interesting and well done "4 hours of any person no matter how interesting gets hard to pay attention to." Another student pointed out that for them "learning from multiple forms helped me review the overall concept of different topics. The more times I reviewed the material, the better!" The combination of both "hearing and seeing information" helped another student regardless of whether it was presented in lecture or group work.

4. Knowledge retention was enhanced by the creation of the concept maps but also by listening to lectures that incorporated stories, clinical examples, and mnemonic devices. An aspect of this theme revolves

around the use of clinical examples to make the material more relevant.

Many students talked about the importance of visualization to help retain information. This was especially true of those who identified themselves as visual learners but others mentioned it, as well. One student explained that "when listening to lectures I tend to retain information better when it is related to a story that I can think back on during the exam." Another pointed out that "I ... feel like I learned stuff from lecture better when stories were applied or ways to remember things were explained to us, such as with AV heart blocks." Along the same lines another student pointed out that "the number one thing that helps to retain the information was the anecdotes/stories to remember things, like the crazy couple for the dysrhythmias." One student went beyond simply retaining information for examinations by stating "I feel that I will remember a lot of your stories for a really long time." Visual devices in general were useful in the retention of material. One student pointed this out by stating that in both lecture and concept mapping "if there were pictures of how things went I retained it better."

Material that has clinical relevance helped some students retain information more effectively. One student pointed out that "when I hear about real-life situations or experiences related to the disease or disorder that we are learning about, it helps me to retain the information." Another student added that "I retained more information when actual case studies from clinical and real-life situations" were incorporated into lectures. A third student mentioned that case

studies can be very dry but that "actual stories from experience stick with me somehow." Concepts applied "to the real world" was important in knowledge retention to a number of students.

5. Some student preferred lecture over group work because instructors know what material is important to focus on and can answer questions. This is especially true if the instructor is animated and uses humor. However if the instructor is not a good teacher then group work is preferred. This theme emerged repeatedly among the second degree students, and less so among the traditional students.

When instructors simply read from power point slides many students felt that learning was dampened. When that happens one student observed "what's the point of coming to class." On the other hand learning is enhanced by an instructor who is "very animated ... and tells quality stories that assist in remembering the topic." One student summed up the feelings of many when she stated that "the teacher can make all the difference."

Question Four

Did you prefer straight lecture or group work?

This was a straight forward quantitative question designed to see if there was any difference between the two cohorts. Twenty-five traditional students and twenty-eight second degree students responded to this question. Table 15 depicts the results. Figures 5 - 7 display the data graphically.

Table 15: Teaching Strategy Preference by Type of Student

Type of Student	Prefer Lecture	Prefer Group Work	No preference
Traditional	8	10	7
Second Degree	18	4	6

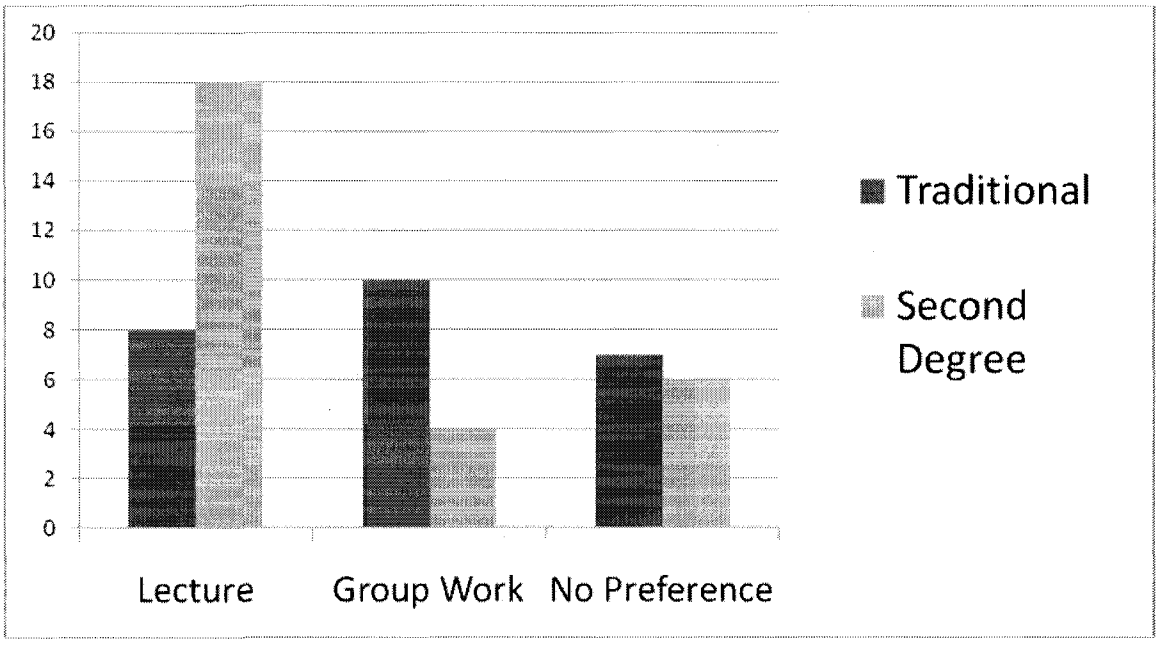


Figure 5: Preference of Teaching Method by Type of Student

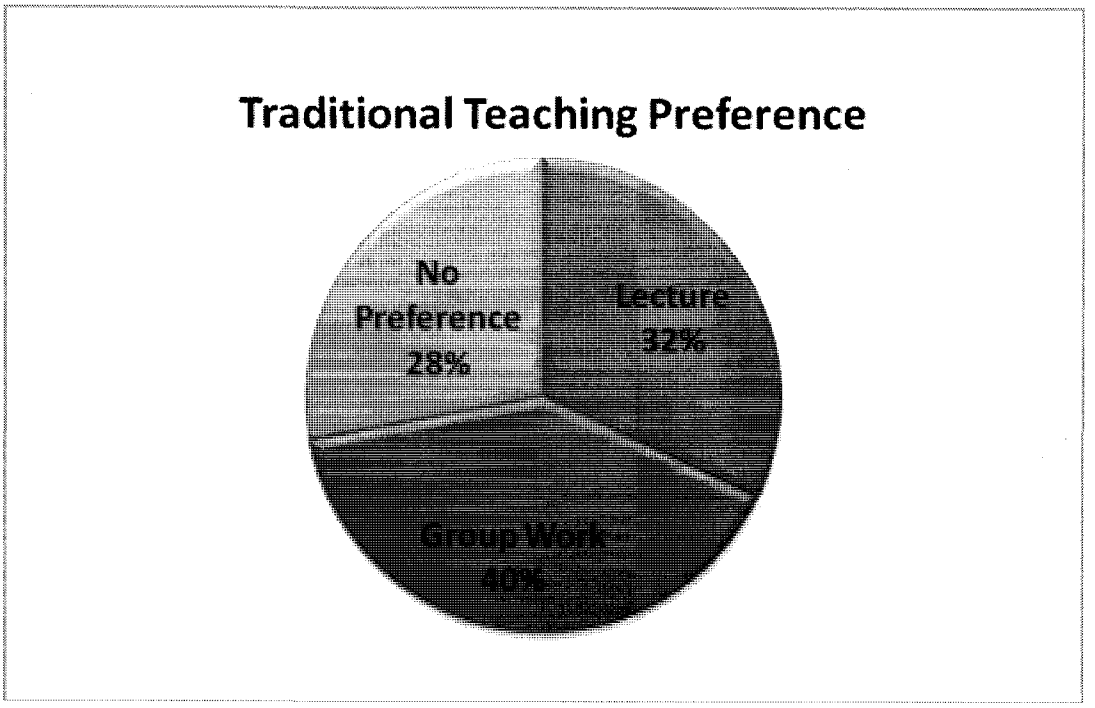


Figure 6: Teaching Method Preference by Traditional Cohort

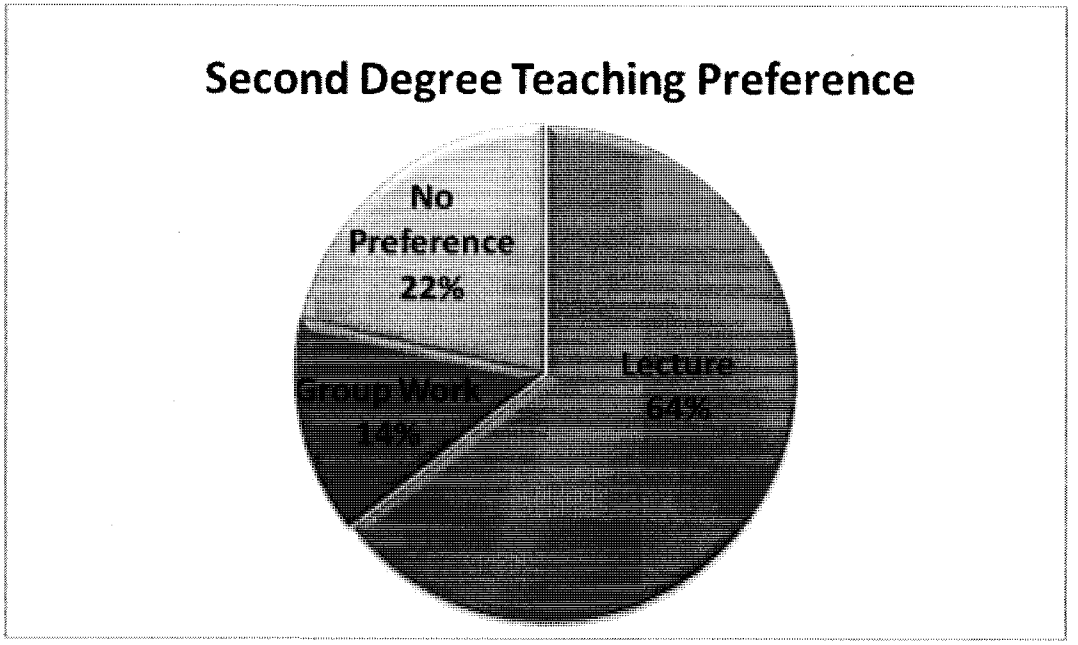


Figure 7: Teaching Method Preference by Second Degree Cohort

SPSS 16.0 was used to examine if there was a statistically significant difference between the two cohorts in their preference for teaching method. A Chi-Square test was used to compare the results. The results were significant ($x^2 = 6.345$, $df = 2$, $p = .042$). There was a medium to strong effect size (phi = .346, p = .042). It is interesting that the earlier questions elicited a great number of positive reports regarding the group work and yet when asked to choose twenty-six students choose lecture and fourteen choose group work. This was especially true in the second degree cohort. A traditional student identified one of the reasons for this when she stated:

> "When it came to me to learn the information from our peers about the different subjects I really did not get anything from their presentations. In fact, I felt that I had extra work to do after learning in this manner because instead of knowing a little about every subject I know a lot about one subject and very little about the others."

This conflict was seconded by another traditional student who reflected:

> "I would have to say that I liked group work the best but only because it got us out of our seats and the day went faster, yet this is heavily shadowed by the fact that I had so much learning that I then had to do on my own afterward that I almost would choose lectures."

Second degree students had more negative responses to this question. One admitted "I preferred the straight lecture because then we know exactly what to cover when we study for the exam." Another was concerned that "I am not getting all the information in group work…I am more confident with a lecture that what is on the test will be covered." A third preferred lecture "because it is usually more structured and I can focus on the information and how I want to structure that in my own mind." Possible explanations for the differences in cohort preferences will be discussed in chapter five.

Question Five

Do you have any additional comments you'd like to add?

There were no new themes that emerged in response to this question. Students either reiterated what they had expressed in answer to questions one through four or spoke about other aspects of the course. Many thanked the instructor overall for the semester. Some students choose not to add any additional comments.

Summary of On-Line Class Responses

Twenty-five traditional students and twenty-eight second degree students entered the Blackboard discussion providing a rich collection of responses. Various themes emerged from the answers given to the first three questions and a statistical analysis was conducted on question number four. Overall students expressed satisfaction with the concept mapping, group work, and in their own teaching but not in learning from each other's teaching. Traditional students listed more positive feelings towards group work than did the second degree students. In chapter five the implications of these answers will be discussed as well as areas for possible future research based on the data analysis and student responses.

CHAPTER FIVE:

DISCUSSION

Introduction

Nursing faculty are challenged to educate students who can assume roles upon graduation that require a high level of critical thinking and application of theory to the care of acutely ill patients. There is a dire nursing shortage across the United States and new graduate nurses often do not have the luxury of working their way into highly technical and intellectually demanding work settings. Therefore they must be trained to have agile minds that can adapt quickly and correctly as they constantly face new problems each day. Health care is not an arena in which answers are clear cut and never changing. Each patient, each diagnosis, and each situation may present in a myriad of ways that requires the nurse to react differently each time. In addition, the areas in which nurses are employed demand close teamwork, communication, and collegiality. The particular make-up of the team often varies from patient to patient. The educator must find ways to stimulate the ability to analyze each new situation, synthesize a plan of action, apply previous knowledge and experience to problem solving and determining correct interventions, and evaluate the success of these interventions. In other words, graduate nurses who can apply higher order learning skills in each work situation both independently and as a member of a dynamic health care team.

The purpose of this study was to compare the effectiveness of constructivist teaching strategies versus a traditional lecture format in the

acquisition of higher order knowledge as determined by test scores. A second purpose was to elicit student feedback regarding their feelings about the two teaching approaches. The conceptual model for this study draws from both neurosciences and cognitive psychology. Learning is defined as the growth of new neuronal dendrites and dendritic connections within the brain (Caine & Caine, 1994; Diamond & Hopson, 1998; Smilkstein, 2003). Learning is also seen as an internal process whereby modifications of existing representations of knowledge occur (Piaget, 1975; Sheull, 1986; Bruner & Haste, 1987). Constructivists believe that teaching strategies can be designed to stimulate the brain's own natural learning ability. Following this line of thought the use of specific constructivist strategies such interactive group work, jigsaw teaching, and concept mapping would lead to and could be measured by an improvement in examination scores. If exams were designed to test the acquisition of higher order cognitive learning it would follow that the use of a brain-based teaching methodology would lead to higher-order learning as reflected on test scores.

Chapter Five is a discussion of the results. It is divided into six sections. Section one summarizes the results; section two discusses both the quantitative results and student responses; section three is concerned with differences between the cohort responses and possible instructor influence on those responses; section four cites possible limitations to the study; section five examines implications for nursing education and section six discusses recommendations for future study.

Summary of Results

A convenience sample of nursing students enrolled in medical surgical nursing during the spring 2008 semester made up the participant group. Data from thirty-three traditional students and thirty-five second degree students was used for data analysis. The students were separated into two cohorts. Four learning units were used for this study. Two of the units were taught using a straight lecture format and two of the units were taught using a combination of brain-based activities in one cohort and reversed for the other cohort. There were three independent variables: type of student, type of teaching strategy, and pre-test / post-test within group change over time on the first two learning units. There were two dependent variables: post-test minus pre-test gain scores and within and between group course examination scores.

Pre-tests and post-tests were given in the first two learning units. Twenty question pre-tests were given immediately preceding both the cardiac and respiratory units and the same tests were given immediately following completion of the units. There was no statistical significance in the gain scores between the two groups based on type of student or teaching method. All students in both cohorts have proven themselves to be successful academically prior to entering the School of Nursing. Admission to the school is highly competitive. The traditional cohort entered as juniors with a 3.85 (out of 4.0) average GPA. The second-degree group had a 3.30 average on their most recent forty-five credits. Both groups have taken a number of science prerequisites in the four semesters prior to entering the program including chemistry, biology, anatomy, physiology,

pathophysiology, pharmacology, and nutrition. Nursing students in this program tend to be excellent test takers. Otherwise they could not have achieved such remarkable grade point averages. It is possible that the lack of statistical differences in gain scores is a reflection of their ability to effectively recall recently learned data and perform in a test situation. It is also possible that these tests were not taken "seriously" as the students were aware that they were taking them anonymously and that the scores had no bearing on their course grades. There was a statistically significant difference between the two groups on the pre and post respiratory tests but in both cases the second degree cohort had higher mean scores. It is unclear as to why this was the case especially since the traditional students scored higher average grades on the respiratory course examination. Perhaps receiving lower scores on the pre-test, post-test quizzes encouraged this group to study the material more thoroughly prior to taking the examination that counted toward their grade.

There was a statistically significant difference in change over time within the two separate cohorts when post-test scores were compared to pre-test scores. This would be expected as the learning unit took place between the two tests. Students would be expected to improve their scores on the post-test following completion of either lecture or brain-based activities.

Course examinations contained questions on the four learning units. The items specific to each learning unit were separated out and totaled. Two of the learning units were relatively short. Approximately seven in-class hours were spent each on the respiratory and gastrointestinal units so the number of

questions on these units was also relatively low. There were fifteen exam items covering the respiratory unit and twenty-nine covering the gastrointestinal unit. There was no statistical difference on test scores based on type of student or on teaching strategy for these two units. The decreased time spent in class on these units and / or the small number of exam items may have also contributed to a lack of any statistical significance. The students did not have as much time to process and reflect on the material and there were not enough questions to differentiate those who knew the material well from those who did not. The cardiac unit and the neurological units were longer. Each of these units lasted between twelve to thirteen hours of in-class time and there were more exam items. There were thirty-one cardiac items and forty-five neurological items. The cohort taught using brain-based activities on the cardiac unit had higher test averages at a marginally statistically significant level ($F = 3.736$, $p = .055$) with a medium effect size ($d = .47$). There was a statistically significant difference in test scores covering the neurological unit with students taught using brain-based activities scoring better on the examination ($F = 4.897$, $p = 0.33$). The effect size was medium with a $d = .55$. It is possible that the number of questions on the neurological examination allowed for better differentiation of scores. The Kuder-Richardson scores for the neurological examination were relatively high (0.603 traditional, 0.591 second degree) but the K-R 20 scores on the gastrointestinal examination were even higher (0.658 and 0.724 respectively) and the difference between cohorts on this latter exam was not statistically significant even though there was a small to medium effect size ($d = .31$).

Percent of correct answers on all examination scores were added up for the four units for each cohort and compared. There was no statistically significant difference in overall percent of correct answers between the cohorts so that independent variable was removed from consideration. A comparison of combined percent scores based on teaching method, however, was statistically significant ($p = .039$). The effect size, however, was relatively small ($d = .25$). It is possible, then, that the use of brain-based activities enhanced learning at least on the longer units.

Twenty-eight second-degree students and twenty-five traditional students answered questions on the discussion board of their Blackboard course shell. The questions were designed to elicit student feelings about the two teaching methods. Results were remarkably similar in terms of what students liked and did not like about the teaching methods with more negative comments coming from the second-degree students. When asked to choose between lecture and constructivist activities, however, second-degree students overwhelmingly chose lecture while traditional students were evenly divided in their preferences for the two strategies. A sampling of student comments will be incorporated into the next section.

Discussion of Student Responses

New dendritic connections can only develop from pre-established neural beds. Piaget (1975) theorized that learners construct new knowledge by building on an internal foundation of existing knowledge through a personal interpretation

of experience. The participants in the current study have a foundation of knowledge about the normal anatomy and physiology of human body systems. They also have a basic understanding of disease processes. In addition, they have completed a semester of fundamental nursing theory, nursing process, and physical assessment. They have acquired basic skills and spent time with patients in either hospital settings or long-term care facilities. Building from this base of knowledge they were asked to construct a concept map of complex disease processes that might include causation, signs and symptoms, diagnostic criteria, nursing diagnoses, goals, interventions, potential complications, and patient educational needs. Instructions stated that the concept map was not designed to be a recitation of facts but rather a linking of the various aspects on which they chose to focus. Students were told that not all aspects of the disease needed to be included, just what was most pertinent from a nursing care perspective. They were asked to create a visual picture of a patient with a specific disease diagnosis. Blanton (2004) believes that concept mapping gives students an opportunity to link new and old knowledge together in a graphic, three-dimensional way.

This concept of building on previous knowledge and "constructing" a personal understanding of the materials was reflected in student comments. One student pointed out that "making the concept maps helped us to organize, prioritize, and pick out the important information" while another reflected that "we were challenged to read and understand the information and then interpret it and re-create it." Along the same lines a student observed that concept mapping

"helps you see connections that you might not work out just hearing about it or reading it." Cognitive learning theories emphasize process over product. While the concept maps were the intended product of the activity, the process of creating them was what one student remembered. "I probably remember more about the cardiac unit...because of the concept maps really simplifying things and allowing you to piece things together without straight memorization." Another student reflected that "when it came time to take a test the recall of the information was from making the concept map instead of reading everything off of the notes." There were more second degree students than traditional students with negative feelings about the exercise but even they had positive comments to make about the experience.

Overall, based on student comments and on examination scores it would appear as though the activity of concept mapping built upon the students' previously established neural networks and that learning took place as reflected in higher test scores. As Smilkstein (2003) stated: "Dendrites, synapses and neural networks grow only from what is already there" (p. 71). Students in the current study were given the opportunity to build from what they already knew.

One of the major themes that arose from student comments was that creating the concept maps in one group and then teaching others was an active way of learning. One student articulated this by stating: "If there is a lot of discussion and class participation I will retain the information a lot better than if I just sit and listen and don't participate. I learned in small groups because of how much I was able to participate." Another student seconded this by stating "I did

enjoy working in groups on the concept maps because it involved active learning and participation and I really learned the material I worked on." A third student pointed out that "working on the concept maps and then teaching each other the content helped us learn the material better because it incorporated may forms of learning." The majority of students felt that by researching a topic, creating a map of that topic, and then teaching the topic to others gave them several opportunities to learn the material in a variety of ways. In other words, they were actively and personally engaged in a process that allowed time for practicing what they had learned. As one student pointed out:

> I definitely felt that teaching each other the material helped me learn better. It was helpful because by playing an active role in creating my concept map with my group, I leaned the information, and then by teaching the information to others, it helped reinforce those concepts."

Using functional magnetic imaging neuroscientist Poldark and his colleagues (2001) discovered that neurons in the basal ganglia were stimulated when subjects were actively engaged in seeking answers and making cognitive associations. When asked to memorize associations rather than discover them on their own the basal structures in these subjects were less active. Neuronal pathways in the basal ganglia are known to be important in memory formation.

Students in this study created their concept maps based on what they, as a small group, decided was important. There were many variations of what was considered "important." Some groups drew pictures of body parts and linked them together in unique and creative ways. Others approached the task in a more straight-forward linear way. Each group had the freedom to decide what to include and how it should be depicted. This honors Smilkstein's (2003) second

principle of human learning: "Dendrites, synapses, and neural networks grow for what is actively, personally, and specifically experienced and practiced" (p. 71).

Constructivists view learning as an active process of discovery that is student focused. Learning is enhanced in a constructivist classroom when students work together. As Brandt and Wolfe (1998) point out: "The brain is innately social and collaborative" (p. 11). Students learn most effectively when they teach others and are able to make immediate use of what they have learned (Sousa, 2001). This was born out in the current study by the finding that there were higher examination scores covering the two longest learning units at a marginally significant or statistically significant level when the unit was taught using a brain based approach versus straight lecture. The longer units gave students more time to research their topics, prepare the concept maps, and present them to others. During these units students seemed to be more relaxed and interactive than when they worked on the shorter units. The longer learning interval coupled with more examination questions may have provided better differentiation between students. Interestingly, the companion lecture-taught units took the same amount of time as the brain-based activities. The difference was that students sat in class during the lectures and did not engage in group-based interactive learning. In these two units students seemed to understand and recall the information more effectively when they had actually interacted and manipulated it in a group setting.

Group activities provide an avenue for students to learn from each other, observe other ways of interpretation and decision making, analyze their own

thought processes, and explore new approaches to problem solving. Many students in this study felt that working together in groups gave them advantages over working alone. One student pointed out that "someone in the group may have understood the concept in a way that could make it easier for someone else to understand. It's always nice to have other people's perspectives." Another student stated that it was helpful to "obtain other students insight on the content and the different ways to understand things. We all think differently." Several students appreciated sharing ways to understand or retain information. One student observed: "Some folks had interesting stories or different ways of remembering information that was helpful...we all look at the information a little differently and have different experiences." Other students pointed out that helping their teammates learn the concepts enhanced their own understanding.

There were many positive reactions to the teaching strategies used. In fact, the majority of students enjoyed working in groups to develop their concept maps. Many comments revealed pleasure in the interactions with classmates. One student pointed out: "I remember more about the cardiac unit than the respiratory unit because...I think we had fun learning it." Another stated: "I like group work because I really enjoy participating in the work and really retain a lot of info (sic) that way." A third traditional student added "I genuinely did enjoy working on the concept maps... I was not always distracted...did better on the tests... and it was way more fun!" This concept of fun was re-iterated many times such as by the student who stated that doing the concept maps and working with others "...was a fun environment making it a better learning

experience." A second degree student echoed this by stating that working in groups on the concept maps "was a fun way to learn the information." Smilkstein (2003) points out that "emotions affect learning" (p. 73). The positive emotions expressed by the majority of students in this study may have led to higher test performance on the brain-based units.

The social aspect of group work appealed to many of the students, particularly the traditional group because it gave them an opportunity to "...hang out with friends." The second degree students were not immune to this appeal as demonstrated by one who stated "...it gave us time to sit down and talk to each other." Some students were excited by the prospect of teaching others and this stimulated their motivation to learn. A traditional student felt that "...you are really excited about the subjects you teach others and that really helps me want to learn the subject."

The social, active, and interactive nature of group concept mapping and peer teaching would enhance dendrite formation according to Smilkstein's (2003) third and fifth rules of human learning: "Dendrites, synapses, and neural networks grow from stimulating experiences" (p. 72) and "Emotions affect learning" (p. 73). At least on the two longer units students who engaged in these activities averaged higher examination scores, possibly indicating a deeper lever of understanding. At any rate they certainly seemed to enjoy the activities.

Many students felt that the opportunity and responsibility to teach their material enhanced their personal learning of their specific topic. Several mentioned the idea that "when creating the concept maps you had to pay

attention so that you would be able to teach the material." As one student reflected, "It was helpful to teach the material to others because you must understand it first to teach it and then you are engaging your mind when you are teaching others about it."

The onus of teaching each other elicited both positive and negative reactions. The responsibility to teach others created an incentive to learn their topic well. On the other hand many students expressed dissatisfaction with the abilities of their classmates to teach. More than half of the students felt that they did not learn adequately when taught by their classmates. This is the one negative that was voiced repeatedly and was the primary reason why the majority of the second degree students as well as many of the traditional students preferred lecture to brain based activities even though they expressed satisfaction with the group work and concept mapping.

The higher examination scores on brain-based units seem to imply that these strategies enhanced student learning. There are three possible explanations for why students seemed to grasp the brain-based materials more fully. First of all, they had to know their topic exceptionally well in order to teach it to others. Secondly, when they felt that their classmates were inadequate teachers they had to spend more out-of-class time studying that material. Third, the brain-based interactive learning activities may have actually resulted in better understanding and retention of the material. It may well have been a combination of all three possibilities.

Cohort Differences and Instructor Influences

There are a number of factors that may have contributed to the slightly different tone in the responses of the two cohorts. Second degree students in this study are older on the average than the traditional students (30.34 versus 22.7). They have all completed a baccalaureate in a field other than nursing and many have worked for years in a different occupation, some in management roles. They are very focused on completing their degrees and moving back into the workforce. An anxiety provoking experience for these students was the additional study time they felt was required in order to learn material that was poorly presented by their colleagues. Increased anxiety and stress may have diminished the pleasure that second-degree students felt during the brain-based learning units. That, in itself, could have affected their ability to learn and retain information and made them feel that more out-of-class study time was required.

Student responses reflected many of these characteristics. Typically, second degree students were very focused on upcoming examinations. One student wrote "I preferred the straight lecture because then we know exactly what to cover when we study for the exam." Another seconded this sentiment by stating "I prefer straight lectures. I always worry that I am not getting all the information in group work. I am more confident with a lecture that what is on the test will be covered." Concern about not getting accurate information was expressed more often and more forcefully by the second degree cohort. One student reflected "I am a fan of straight lectures, because I liked getting accurate information explained in an organized manner from the "expert"."

Student preference in this cohort was very dependent on the instructor. If the instructor was knowledgeable, stimulating, and interactive many preferred lecture. If the instructor merely read from power point slides and did not engage the class more preferred group work. The second degree students spent the majority of the semester with the researcher who was their primary instructor and course coordinator. Many of the students had developed a close affiliation with this instructor who helped them navigate problems with registration, scheduling and adjustment to their return to school. They were also accustomed to the researcher's style of teaching.

The second degree nursing students at this university are similar to those described in a number of studies in that they are highly motivated and very demanding. They work hard but expect to receive a quality education for their efforts. Many are working full time or three-quarter time and juggling family responsibilities as well as school and work. Some are primary wage earners in their family. To complicate their lives many commute. They are not always welcoming to new faculty and to new teaching approaches. Their comments reflected the resistance some felt about having to make appropriate adjustments. One student stated: "It was hard for me to have several lecturers for one class...I felt as though I had to change my study habits and the way I prepared for exams each time we had a new lecturer and it was uncomfortable." Another pointed out that he/she "...preferred straight lecture because you hear the information from the same lecturer."

In this researcher's experience second degree students are very focused on the end product – a nursing degree. They often seem driven from exam to exam and course to course as they move closer to the ultimate goal: graduation. There is more observable drama and angst in this group. They are also highly competitive both with each other and with themselves. As a rule, they do not seem to be as upbeat or satisfied as traditional students. It is not surprising, therefore, to find more negativity in their responses.

Instructor characteristics were much less important to the traditional cohort. In general the traditional students enjoyed the variety offered by the combination of lecture and interactive activities. They were happy when lectures were engaging and interactive but did not mind having a number of different instructors and were less critical overall.

Limitations of the study

Study results may have been affected by a number of limitations in design and implementation. The sample size was relatively small. The two cohorts were not homogenous although there was no statistical difference in examination scores based on the type of student. Nevertheless, there were some overall differences in student responses based on the cohort to which they belonged. The second degree students had a prior relationship, and to some extent, attachment to the researcher who was their primary professor. The traditional students knew the researcher only as a guest faculty member. The researcher

had been part of the interview process for half of the second degree students and had taught the entire cohort in a previous semester.

Other limitations relate to implementation issues. The examinations were not equal in length. In fact the only unit in which the mean scores were higher for lecture versus brain-based group work only had fifteen exam questions. That may have not been an adequate number to reveal true differences. This study only examined short-term knowledge retention in that the examinations were given two to four weeks post learning unit. Students had not had opportunities prior to this study to engage in the brain-based teaching methods utilized so they had a learning curve unrelated to course content.

There was also a limitation related to data analysis. Qualitative data analysis was descriptive only with no triangulation from a second analyst. It would be helpful at this time to more fully explore student responses using more sophisticated strategies. It would also be interesting to quantitatively compare examination items with high point biserials to determine if the higher values are reflective of teaching strategy.

On a personal note, it is impossible for me to lecture in a straightforward and non-energetic manner. It is very important for my students to leave class understanding the material and so I incorporate many case studies and mnemonic devices to stimulate learning. To counteract this becoming a complicating variable I was consistent in my teaching style regardless of the content or cohort being taught. Nevertheless, when I was teaching the traditional students, the second degree students had a different instructor and many of

them expressed dissatisfaction with this arrangement. This was clearly reflected in their comments.

Implications for Nursing Education

There was a statistically significant difference on overall examination scores based on teaching strategy. Mean scores on three of the four learning units were higher when brain-based constructivist activities were incorporated into the classroom versus straight lecture. Students also provided thoughtful and helpful comments about their experiences with the different strategies. A number of recommendations can be made based on this data.

1. A combination of lecture, group-work, and interactive projects such as concept mapping may result in increased pleasure with learning and the acquisition of higher order cognition as measured by examination scores.

2. The emotional environment of the classroom must be positive and supportive, yet challenging and stimulating. Group work that is not directly tied to grades and that does not require a large out-of-class time commitment provides variety and social learning opportunities. It also helps set the stage for professional collaboration.

3. Group work should be incorporated whenever time is available and subject matter is appropriate. Students in this study repeatedly cited the pleasure that they experienced working with their classmates. Concept mapping allowed them to create visual maps of the information in their books and notes. Even many of the students who ultimately choose lecture over group work as their

preferred teaching method spoke about the advantages of group work. As one student pointed out:

> The fact that we all look at the information a little differently and have different experiences was helpful when doing group work. I also liked having the opportunity to practice presenting information in front of a group since I don't do that as much anymore. In addition, if there were questions I had that weren't answered, I could look that up later and I felt I learned that subject a little better from doing so.

However, this same student later added: "I honestly prefer straight lecture most of the time because it is usually more structured and I can focus on the information and how I want to structure that in my own mind."

4. Interactive group learning and teaching opportunities should be provided throughout the nursing program. Students should be given the opportunity to teach each other in non-threatening ways. The biggest downside to the experiences that students had in this study was the frustration with teaching provided by their peers. Students need to be acculturated to this type of classroom strategy. In the first semester instructors could role-model the level of teaching expected. Students could then work in groups preparing topics and teaching each other with faculty present to provide feedback, clarify confusing information, and help answer questions. In subsequent semesters students would gradually take on more responsibility for both their group activities as well as their own teaching. As the content becomes more complex, students will have a basis of experience in both learning together and teaching each other. Faculty may want to continue to role model their expectations early in the semester and then give on-going feedback to help improve peer teaching. Smilkstein's (2003) fourth rule is "use it or lose it" (p.72). Incorporating this

teaching strategy throughout the curriculum would give students ample opportunities to use what they are learning in a variety of ways.

5. Short introductory lectures at the beginning of a unit have several advantages. The instructor can provide important background information as well as incorporate material not found in the assigned textbook. Up-to-date information can be shared. This is an important consideration in a dynamic field such as nursing where on-going research is changing our understanding of disease processes and the approach to treatment. The lecture can also help the students focus on what will be included in the learning unit and what is essential to study and understand.

6. Lectures should incorporate case studies, metaphors, analogies, and other mnemonic devices to help students organize data, make connections, and remember relevant information. Several students in this study remembered cardiac heart blocks because of the mnemonic story with which it was taught. The lecture, itself, should be interactive. The instructor should pepper a presentation with questions and opportunities to apply theory to practice. The questions can help students get used to higher order learning if the answers require application, analysis, and synthesis rather than memorization. Asking thought-provoking questions can engage student attention and stimulate critical-thinking.

7. Power point slides used in lecture presentations should contain bullets only and be used as a guide and reference to the lecture. If an instructor simply

reads from the slides, students loose attention, interest, and motivation. Some even stop coming to class.

Recommendations for Future Study

Results from this study indicated that the acquisition of higher order learning may be facilitated by the use of interactive constructivist teaching methods. It would be interesting to examine whether students from this study demonstrate any long term memory differences on the four learning units. During their fifth and final semester students take a battery of practice and proctored exams designed by Assessments Technology Institute (ATI) to prepare them for the National Council Licensure Examination (NCLEX) which they must pass in order to be licensed as a Registered Nurse. Results from the ATI exams could be separated into the four learning units and then compared by both cohort and teaching method to see if there are any differences.

It would also be useful to introduce the teaching methods into the first semester classes and continue them in their second semester when they are enrolled in medical-surgical nursing. Examination scores in both semesters could be compared by teaching method. Examination scores could be compared both before and after students are more comfortable and skillful with the classroom activities.

Collaboration across departments could be another avenue of study. It would be interesting to utilize the same study approach to students enrolled in non-nursing courses. There is currently an interdisciplinary Research Interest

Group (RIG) focused on educational practices on the campus in which this study was conducted. This could be an excellent group to approach with such an idea.

Another avenue of research would be to examine the effect of various mnemonics on higher order knowledge retention. Students repeatedly cited examples from course lectures of stories, case studies, metaphors, and analogies that aided their understanding and memory of class materials. A study similar to the current study could be designed to look at examination score differences based on the use of lecture based mnemonics.

An exciting area of research would involve collaborating with neuroscientists who study brain activity using functional MRI scanners. Scans could be taken before and after alternative teaching approaches to examine differences in neurological activity and potentially in neurological structures.

Conclusion

The purpose of this quasi-experimental quantitative mixed design study was to compare the effectiveness of brain-based teaching strategies versus a traditional lecture format in the acquisition of higher order cognition as determined by test scores. There was a statistically significant difference in overall scores ($p < .05$) on units taught via brain-based activities versus straight lecture regardless of type of student with brain-based unit scores higher than lecture-only unit scores. This has important implications for nurse educators who are challenged to graduate nurses able to perform in a complex and ever-changing work environment. The knowledge and skills required of twenty-first

century nurses cannot be memorized and recalled for each and every situation. The nurse must be prepared to respond to a myriad of challenges, often experienced for the first time, on a day-to-day basis. The dynamic nature of nursing requires an ability to analyze each situation, synthesize a plan of action, apply underlying knowledge and experience in completing the appropriate interventions, and evaluate the results. Throughout the curriculum students must therefore be required to problem solve, think critically, and determine relevance while engaging in complex cognitive activities. Students must be active participants in both the classroom and in clinical settings. Bain (2004) advises educators to encourage students to "compare, apply, evaluate, analyze, and synthesize, but never only to listen and remember" (p. B8). This study adds to the body of knowledge about how to develop strategies to meet that goal.

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LIST OF APPENDICES:

Appendix A: Colorado State University IRB Approval

Colorado State University

Research Integrity & Compliance Review Office
Office of Vice President for Research
Fort Collins, CO 80523-2011
(970) 491-1553
FAX: (970) 491-2293

Notice of Approval for Human Research

Principal Investigator: Gene Gloeckner, Education, 1588
Co-Principal Investigator: Alison Merrill, Education, alison.merrill@unco.edu

Title: The Impact of Constructivist Teaching Strategies on Higher Order Cognition and Learning

Protocol #: 08-017H **Funding Source:** n/a

Number approved: 72 participants
Committee Action: **Approval Date:** February 13, 2008 **Expires:** January 31, 2009

IRB Administrator: Janell Barker Janell Barker

Consent Process:
Because of the nature of this research, it will not be necessary to obtain a signed consent form. However, all subjects must receive a copy of the approved cover letter printed on department letterhead. The requirement of documentation of a consent form is waived under § __.117(c)(2).

Investigator Responsibilities:

- It is the PI's responsibility to obtain consent from all subjects.
- It is the responsibility of the PI to immediately inform the Committee of any serious complications, unexpected risks, or injuries resulting from this research.
- It is also the PI's responsibility to notify the Committee of any changes in experimental design, participant population, consent procedures or documents. This can be done with a memo describing the changes and submitting any altered documents.
- Students serving as Co-Principal Investigators must obtain PI approval for any changes prior to submitting the proposed changes to the IRB for review and approval.
- The PI is ultimately responsible for the conduct of the project.
- A status report of this project will be required within a 12-month period from the date of review. Renewal is the PI's responsibility, but as a courtesy, a reminder will be sent approximately two months before the protocol expires. The PI will be asked to report on the numbers of subjects who have participated this year and project-to-date, problems encountered, and provide a verifying copy of the consent form or cover letter used. The necessary continuation form (H-101) is available from the RICRO web page http://ricro.research.colostate.edu.
- Upon completion of the project, an H-101 should be submitted as a close-out report.
- If approval did not accompany a proposal when it was submitted to a sponsor, it is the PI's responsibility to provide the sponsor with the approval notice. This approval is issued under Colorado State University's OHRP Federal Wide Assurance 00000647.
- **Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.**

Please direct any questions about the Committee's action on this project to me for routing to the Committee. Additional information is available from the RICRO web site at http://ricro.research.colostate.edu.

Attachment Date of Correspondence: 2/26/08

Merrill, Alison

From: Barker,Janell [Janell.Barker@Research.ColoState.edU]
Sent: Wednesday, February 13, 2008 12:14 PM
To: Merrill, Alison; Gloeckner,Gene
Subject: RE: human research, Gloeckner, The Impact of Constructivist Teaching ...

Alison,
Your cover letter that you submitted with changes is acceptable.

Your project, The Impact of Constructivist Teaching Strategies on Higher Order Cognition and Learning, has been approved as of February 13, 2008 with the condition that the revised cover letter is used and given to participants on CSU letterhead and UNC IRB approval for the revised cover letter is obtained prior to use. Please submit UNC's approval for the revision via an email/letter/fax.

The IRB ID# is 08-017H. Approval is for a maximum of 72 participants.
The approval is being processed and will be sent in the next several days outlining the PI's responsibilities and more details of the approval.

Good luck with your research.
Janell

* THE HRC IS NOW KNOWN AS THE IRB (INSTITUTIONAL REVIEW BOARD)
* Janell Barker IRB Administrator Research Integrity & Compliance Review Office
321 General Services Building
Colorado State University
Fort Collins, CO 80523-2011
Janell.Barker@Research.Colostate.edu
970-491-1655
FAX: 970-491-2293
http://ricro.research.colostate.edu

Appendix B: University of Northern Colorado Institutional Review Board Approval

UNC INSTITUTIONAL REVIEW BOARD

Request for Change in Protocol

UNIVERSITY of NORTHERN COLORADO

Date of Original IRB Approval: 1/22/08

Project Title: The Impact of Constructivist Teaching Strategies on Higher Order Cognition and Learning

Lead Investigator	Name:	Alison Merrill
	Department:	School of Nursing
	Telephone:	351-1389
	Email:	alison.merrill@unco.edu
Research Advisor (if applicable)	Name:	
	Department:	
	Telephone:	
	Email:	

On a separate page, describe and provide justification for the changes being proposed. Be concise and specific in describing methodological changes that affect the experience of participants and/or relate to the risks/benefits of participation. Explain why these changes are necessary.

X Yes ___ No The proposed changes in protocol will necessitate changes in documents such as recruitment flyers, consent forms, debriefing forms, or other project-related documents.

X Yes ___ No If yes, copies of the revised documents with changes highlighted are attached to this request.

CERTIFICATION OF LEAD INVESTIGATOR
I certify that information contained in this request is complete and accurate.

Alison J Merrill 2/15/07
Signature of Lead Investigator Date of Signature

CERTIFICATION OF RESEARCH ADVISOR (If Lead Investigator is a Student)
I certify that information contained in this request is complete and accurate.

Signature of Research Advisor Date of Signature

Approved by: Nancy White 2/25/08
Chairperson, Institutional Review Board Date

Date Request Received by SPARC:

Appendix C: Lecture Schedules for Spring 2008

NURS 385/386 Spring 2008 Lecture Schedule

Week	Date	Day	Topics	Faculty
1	1/17/08	R	Course Orientation Family Centered Care (3 hours) Fluids and Electrolytes (1 hour)	Alison Merrill Kat Johnson Alison Merrill
	1/18/08	F	Fluids and Electrolytes (4 hours)	Alison Merrill
2	1/24/08	R	Fluids & Electrolytes (2 hours) Acid Base Balance (2 hours)	Alison Merrill
	1/25/08	F	Pediatric Fluids & Electrolytes (1 hour) Adult Cardiac (3 hours)	Kat Johnson Alison Merrill
3	1/31/08	R	**NURS 385 Exam 1: Family Centered Care; Fluids & Electrolytes; Acid Base Balance (1 hour)** Adult Cardiac (3 hours)	Alison Merrill
	2/1/08	F	Adult Cardiac (4 hours)	Alison Merrill
4	2/7/08	R	Adult Cardiac (1 hour) Shock and Multiple Organ Dysfunction (1 hour) Adult Respiratory (2 hours)	Alison Merrill
	2/8/08	F	Adult Respiratory (4 hours)	Alison Merrill
5	2/14/08	R	Adult Respiratory (1 hour) Pediatric Cardiac/Respiratory (3 hours)	Alison Merrill Kat Johnson
	2/15/08	F	Pediatric Cardiac/Respiratory (1 hours) Adult GI (3 hours)	Kat Johnson Alison Merrill
6	2/21/08	R	**NURS 385 Exam 2 – Cardiac;Shock;Respiratory** Adult GI (3 hours)	Alison Merrill
	2/22/08	F	Adult GI (2 hours) Pediatric GI (2 hours)	Alison Merrill Kat Johnson
7	2/28/08	R	Adult Immune (4 hours)	Melissa Henry
	2/29/08	F	Adult Immune (1 hours) Pediatric Immune (2 hours) Adult Sensory (1 hour)	Melissa Henry Kat Johnson Melissa Henry
8	3/6/08	R	**NURS 385 Exam 3 – GI; Immune** Adult Sensory (1 hour) Pediatric Sensory (2 hours)	Melissa Henry Kat Johnson
	3/7/08	F	**Nursing 386 Starts** Adult Uro/Renal (4 hours)	Liz Davis
9	3/13/08	R	Adult Uro/Renal (3 hours) Pediatric Uro/Renal (1 hour)	Liz Davis Kat Johnson
	3/14/08	F	Pediatric Uro/Renal (1 hour) Adult Endocrine (3 hours)	Kat Johnson Melissa Henry
10	3/20/08	R	Spring Break	
	3/21/08	F	Spring Break	
11	3/27/08	R	Adult Endocrine (4 hours)	Melissa Henry
	3/28/08	F	Adult Endocrine (1 hours) Pediatric Endocrine (2 hours) Adult Oncology (1 hour)	Melissa Henry Kat Johnson Rhonda Squires
12	4/3/08	R	**NURS 386 Exam 1 – Uro/Renal;Sensory;Endocrine** Adult Oncology (3 hours)	Rhonda Squires
	4/4/08	F	Adult Oncology (2 hours) Adult Hematology (2 hours)	Rhonda Squires
13	4/10/08	R	Adult Hematology (4 hours)	Rhonda Squires
	4/11/08	F	Pediatric Oncology/Hematology (4 hours)	Kat Johnson

14	4/17/08	R	**NURS 386 Exam 2 – Oncology; Hematology** Adult Musculoskeletal (3 hours)	Rhonda Squires
	4/18/08	F	Pediatric Musculosekeltal (1 hour) Burns (2 hours) Integumentary (1 hours)	Kat Johnson TBA Liz Davis
15	4/24/08	R	Adult Neurological (4 hours)	Alison Merrill
	4/25/08	F	Adult Neurological (4 hours)	Alison Merrill
16	5/1/08	R	Adult Neurological (4 hours)	Alison Merrill
	5/2/08	F	Pediatric Neuro (4 hours)	Kat Johnson
	TBA 5/5-8/08		**NURS 386 Exam 3 – Musculoskeletal; Burns; Integumentary; Neurological**	

Nursing 375/376 Spring 2008 Lecture Schedule

Week	Date	Day	Topics	Faculty
1	1/17/08	R	Course Orientation (1 hour) Patient Education (2 hours) Perioperative Nursing (1 hour)	Liz Davis
	1/18/08	F	Perioperative Nursing (3 hours)	Liz Davis
2	1/24/08	R	Fluid & Electrolytes (4 hours)	Liz Davis
	1/25/08	F	Fluid & Electrolytes (3 hours) Acid Base Imbalances (2 hours)	Liz Davis
3	1/31/08	R	Fluid & Electrolytes & Acid Base (1hour) Immune (3 hours)	Liz Davis Elly Peters
	2/1/08	F	Immune (3 hour)	Elly Peters
4	2/7/08	R	**NURS 375 Exam 1 –Patient Education, Perioperative Nursing, Immune, Fluid & Electrolytes, Acid Base Imbalance** Oncology (2.5 hours)	Elly Peters
	2/8/08	F	Oncology (3 hour)	Elly Peters
5	2/14/08	R	Oncology (1 hour) Hematology (3 hours)	Elly Peters
	2/15/08	F	Hematology (3 hours)	Elly Peters
6	2/21/08	R	**NURS 375 Exam 2 – Oncology & Hematology** Endocrine (2.5 hours)	Elly Peters
	2/22/08	F	Endocrine (3 hours)	Elly Peters
7	2/28/08	R	Endocrine (3 hour) Gastrointestinal (1 hours)	Elly Peters Alison Merrill
	2/29/08	F	Gastrointestinal (3 hours)	Alison Merrill
8	3/6/08	R	Gastrointestinal, Liver, Pancreas (4 hours)	Alison Merrill
	3/7/08	F	Cardiac (3 hours)	Alison Merrill
9	3/13/08	R	**NURS 375 Exam 3 – Endocrine & Gastrointestinal** Cardiac (2.5 hours)	Alison Merrill
	3/14/08	F	Cardiac (3 hours)	Alison Merrill
10	3/20/08	R	Spring Break	
	3/21/08	F	Spring Break	
11	3/27/08	R	Cardiac & Shock (4 hours)	Alison Merrill
	3/28/08	F	**NURS 376 Course** Respiratory (3 hours)	Alison Merrill
12	4/3/08	R	Respiratory (4 hours)	Alison Merrill
	4/4/08	F	Neurological (3 hours)	Alison Merrill
13	4/10/08	R	**NURS 376 Exam 1 – Cardiac & Respiratory** Neurological (2.5 hours)	Alison Merrill
	4/11/08	F	Neurological (3 hours)	Alison Merrill
14	4/17/08	R	Neurological (2 hours) Sensory (2 hours)	Alison Merrill Liz Davis
	4/18/08	F	Burns (2 hours) Integumentary (1 hours)	Liz Davis
15	4/24/08	R	**NURS 376 Exam 2 – Neurological, Sensory, Burns, Integumentary** Musculoskeletal (2.5 hours)	Liz Davis

	4/25/08	F	Musculoskeletal (2 hors) Urological/Renal (1 hour)	Liz Davis
16	5/1/08	R	Urological/Renal (4 hours)	Liz Davis
	5/2/08	F	Urological/Renal (3 hours)	Liz Davis
	TBA 5/5- 8/08		**NURS 376 Exam 3 – Musculoskeletal & Urological/Renal and Comprehensive**	Liz Davis

Appendix D: Instructions to Students

Jigsaw group work and concept mapping

We are now going to break into groups for an interactive learning activity. There are six disease topics listed on the board. I want you to break up into groups of six and choose one of the topics. You will have time to work with your group on that topic. Here are the things that you will be doing:

1. Research the topic so that you can create a concept map similar to the one we did together as a class. For each topic include what you consider to be the most important information for your classmates to know. You do not have to include everything that you learn about the topic on your map.

2. Your concept map should create a picture of your topic. In other words, don't just list things. You want to "tell a story" with your map. Some of the things you *might* want to include are causes, underlying pathophysiology, signs and symptoms, medical treatment, nursing care considerations, patient education, and discharge planning. Be sure to connect the different aspects of the disease. Be as creative as you want. There are large sheets of paper, construction paper, lots of markers, and scissors available. Ask yourselves: "What are the most important things about this diagnosis that we, as nurses, need to know to safely care for this patient."

3. After you have created your map be sure that everyone in your group understands the material so that you are each comfortable teaching it to others. Then post your map somewhere in the skills lab.

After the concept maps are completed

4. Now we are going to break up into different groups of six. One person from each concept map group will be represented in the new group of six. You will move around the room with your new group to each concept map. The person in your group who worked on the map you are viewing will then teach the rest of the group about the map.

5. I will be available throughout the exercise to answer questions.

Have fun with this!

Appendix E: Cardiac Post-Test

Post-test: Cardiac Disorders
Spring 2008

1. The CK-MB and Troponin tests on blood serum of the patient with myocardial infarction are valuable because they reveal:

   a. the presence of an antibodies in the blood
   b. that the heart muscle has been damaged
   c. the invasion of the pericardial sac by bacteria
   d. the presence of a clotted mass of blood

2. The nurse is monitoring a patient with possible coronary artery disease who is undergoing exercise (stress) testing on a treadmill. The symptom that has the most immediate implications for the patient's care during the exercise testing is

   a. the BP rising from 134/68 to 150/80 mm Hg.
   b. the heart rate (HR) increasing from 80 to 96 beats/min.
   c. the patient complaining of feeling short of breath.
   d. the ECG indicating the presence of coronary ischemia.

3. Which of the following is the major potential complication of thrombolytic therapy?

   a. pulmonary emboli
   b. bleeding
   c. pain
   d. paralysis

4. Which of the following symptoms indicates a limb-threatening ischemia?

   a. red, hot skin, bounding pulse in extremity
   b. thickened toenails and capillary refill less than 3 seconds
   c. pale, cool skin and diminished pulse
   d. anklebrachial index of 1 and postural color changes of feet

5. The nurse is caring for a patient who develops ventricular fibrillation. Which of the following should the nurse do first?

   a. Administer intravenous digoxin as prescribed.
   b. Set up for a temporary pacemaker insertion.
   c. Administer morphine sulfate as prescribed.
   d. Call a cardiac code and prepare for cardioversion.

6. The nurse is admitting a patient with a medical diagnosis of congestive heart failure. Priority nursing assessment should be directed toward which of the following?

   a. mental status and remote memory
   b. dyspnea and auscultating for crackles.
   c. chest pain and auscultating for a heart murmur.
   d. oliguria, urgency, and hypertension

7. The nurse is caring for a patient 2 days post-myocardial infarction. The nurse is assisting the patient to sit up a chair. For which of the following reasons would the nurse return the patient to bed immediately?

   a. heart rate increases by 10 beats per minute.
   b. patient complains of fatigue and lethargy.
   c. ECG shows frequent multifocal PVC"s.
   d. pulse oximetry reading is 92% on room air.

8. The RN is observing a student nurse who is doing a physical assessment on a patient. The RN will need to intervene immediately if the student nurse

   a. presses on the skin over the tibia for 10 seconds to check for edema.
   b. palpates both carotid arteries simultaneously to compare pulse quality.
   c. places the patient in the left lateral position to check for the PMI.
   d. uses the palm of the hand to assess extremity skin temperature.

9. The nurse is caring for an adult patient who complains of severe aching, throbbing pain in the left forefoot. The patient describes the pain as being more severe at night and slightly relieved by dangling the affected extremity from the bed. The nurse would interpret this pain as related to which of the following?

   a. arterial insufficiency.
   b. venous insufficiency.
   c. muscle spasms.
   d. lymphedema.

10. The nurse is performing a health screening on residents of a retirement community. The nurse would identify which of the following persons as being at highest risk for peripheral vascular disease (PVD)?

    a. an obese woman with a serum cholesterol of 220 mg/dL.
    b. a frail woman with hypertension and dehydration.
    c. a man with a two previous myocardial infarctions.
    d. a diabetic man who smokes ½ pack per day.

11. The nurse is caring for an elderly client with hypertension who has been noncompliant to treatment. The nurse would assess for complications of the disorder by observing for signs of:

    a. congestive heart failure.
    b. gastrointestinal ulceration.
    c. petechial hemorrhage.
    d. psychiatric disturbances.

12. During client assessment the nurse identified jugular venous distention. The evaluation of this finding is that the client may be manifesting.

    a. Left-sided heart failure.
    b. Right-sided heart failure.
    c. Dehydration.
    d. Pulmonary congestion.

13. The nurse is preparing to administer a drug with a therapeutic effect of decreasing cardiac afterload. It would be most important for the nurse to monitor which of the following parameters?

    a. Cardiac rhythm.
    b. Urinary output.
    c. Heart tones.
    d. Blood pressure.

14. The nurse is teaching a patient who is to have a pulmonary artery catheter (Swan-Ganz catheter) inserted preoperatively. The nurse describes the purpose of this catheter by telling the patient which of the following?

    a. The catheter eliminates the need for frequent blood pressure monitoring.
    b. The catheter provides information about both the right and left sides of the heart.
    c. The catheter measures the patency of the coronary arteries.
    d. The catheter gives information about electrical impulses regulating the heart's rhythm.

15. The nurse is evaluating the response to treatment for a patient who has recently started taking furosemide (Lasix) to treat stage 2 hypertension. The information that will require the nurse to act most rapidly is a (n)

a. blood potassium of 3.0 mEq/L.
b. blood glucose level of 180 mg/dl.
c. BP reading of 164/96.
d. orthostatic decrease of 12mm Hg..

16. The nurse has received change-of-shift report about all of these patients on the telemetry unit. Which patient should the nurse see first?

a. A patient with atrial fibrillation, rate 88, who has a new warfarin (Courmadin) order.
b. A patient with type 1 second-degree AV block, rate 60, who is dizzy when ambulating.
c. A patient who is in sinus rhythm, rate 98, after having electrical cardioversion 2 hours ago.
d. A patient whose ICD (implantable cardioverter- defibrillator) fired three times today who is scheduled for a dose of amiodarone (Carodarone).

17. A 90-year-old female is to be transfused with two units of packed red blood cells. Lasix (furosemide) 80 mg IVP has been ordered after the first unit of blood has been infused. The client asks why she is getting Lasix IVP. The nurse replies that its purpose is to:

a. prevent circulatory overload.
b. prevent pulmonary emboli.
c. decrease blood pressure.
d. counteract transfusion induced hypercalcemia.

18. Intermittent claudication is a symptom that results from:

a. inadequate blood flow to the skin after heat application.
b. beginning gangrene in the toes and feet.
c. dorsiflexion of the foot when phlebitis is present.
d. inadequate blood flow to the muscles during exercise.

19. The nurse identifies the nursing diagnosis of decreased cardiac output related to valvular insufficiency for the patient with infective endocarditis based on the assessment finding of

a. petechiae of the buccal mucosa and conjunctiva.
b fever, chills, and diaphoresis.
c. urine output less than 30 ml/hr.
d. an increase in pulse rate of 15 beats/min with activity.

20. The nurse has identified a nursing diagnosis of acute pain related to an inflammatory process for a patient with acute pericarditis. The most appropriate intervention by the nurse for this problem is to

a. position the patient in Fowler's position, leaning forward on the overbed table.
b. force fluids to 3000 ml/day to decrease fever and inflammation.
c. teach the patient to take deep, slow respirations to control the pain.
d. remind the patient to ask for the opioid pain medication every four hours.

Appendix F: On-line Qualitative Responses

Traditional Cohort

1. Did you enjoy working in groups on the concept maps? Why or why not.

I did enjoy working on the concept maps as a group because someone in the group may have understood the concept in a way that could make it easier for someone else to understand. It's always nice to have other people's perspectives as well.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I think having the groups present the concept maps helped me to familiarize myself with the material, but in order to gain a deeper understanding I had to do the learning myself. I do think presenting the concept maps was good for a general understanding of the material though, and was useful.

3. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

Participating in the group work helped me retain the information for the exams. But having lecture helped me grasp the concepts as well. I think it was most useful to have the day broken up in to group work and lecture.

4. Please feel free to add any additional comments.

I preferred the group work because it allowed communication between class mates, and allowed a deeper understanding of the concept I worked on within my group. I also liked having other perspectives (although you give great lectures).

Did you enjoy working in groups on the concept maps? Why or why not.

> I ready did enjoy working in groups because it was a great opportunity to interact and learn from each other.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I like the concept map and teaching each other because it is good way to teach and learn at the same time. Whatever subject you teach others really stays with you and I think that's what is helpful about it.

2. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

   Sometimes I would rather listen to lecture but in some subjects, group participation in group work.

3. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

> I found it very helpful to have group work with cardiac and GI because it really helps to have it all outlined and draw it out. Respiratory and Neuro units are just fine as lecture. I remember cardiac unite than respiratory because I think cardiac unite was very interesting and I think we had fun learning it. Especially the AV heart blocks, I would not forget.

4. Please feel free to add any additional comments.

I think learning depends on who is teaching and how much the teacher knows about the subject.

---

1. Did you enjoy working in groups on the concept maps? Why or why not.

I really did enjoy the group work a lot, I think that researching a particular concept in depth makes a big difference in how I retained the information on that particular concept.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

While I felt that I learned a lot about the information that I researched, I did not learn as much from the other groups as I did during lecture, probably because all they did was lecture what they knew but they were not as good at lecturing as you.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

When it comes to lectures it depends on how the lecture is presented as to whether or not I will retain the information. If there is a lot of discussion and class participation I will retain the information a lot better than if I just sit and listen and don't participate. I learned in small groups because of how much I was able to participate.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I honestly like them both but in different ways. I think that lectures are informative but it really depends on who is lecturing and their style of teaching. I like group work because I really enjoy participating in the work and I really retain a lot of info that way. I remember more about the cardiac unit because that is the unit that I studied the most. I also studied that unit in a group whereas I studied respiratory by myself and didn't remember as much.

5. Please feel free to add any additional comments.

I really enjoyed this class! Thank you so much for all of your time and effort, it was really worth it to all of us because we learned so much from you!

---

1. Did you enjoy working in groups on the concept maps? Why or why not.

I enjoyed working together in a group of five or four because we were able to use the concept maps during test time. even though it was a bit strenous to get everything together, i though i learned a lot from these concept maps activities.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I though teaching other was a bit hard because each of us took a part of the map concept and for myself, i didn't know anything else besides my own information. but i did enjoy teaching other about my disease, illness, and etc.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

For the most part i didn't retain much from the lecturs and i had to soly rely on reading my notes and reading all the chapters. I have a hard time paying attention in class because of my short attention span but when something of interest was being preached, my ability to retain the information was less

difficult. For me retaining the informatio isn't the problem, its more like the structure of the questions that is causing my problem.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I prefer a mixutre of both. Some chapters are more difficult than others and i believe that lecturs is the only solution to those ones.

5. Please feel free to add any additional comments.

I feel that we should be given more extra credit and of course increased time inbetween our test. I know that nursing is an important part of my life but i also feel that without other things in my life like family, activities, and social stuff, i don't think i could continue living this way like lindsey. I feel a bit isolated but maybe that is just me.

---

1. Did you enjoy working in groups on the concept maps? Why or why not.

I did enjoy working in groups on the concept maps because it involved active learning and participation and I really learned the material that I worked on but at the same time I really only learned the material that I worked on.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

The material that my group was responsible for, I learned well. Typically my groups would split up the information and research that certain aspect of the disease and then write in that part of the poster and then at the end my group would gather and make sure that every one understood the entire disease before we would all spit and teach our subject. This system worked well; however, when it came time to learn the information from our peers about the different subjects I really did not get anything from their presentations. In fact, I felt that I had extra work to do after leaning in this manner because instead of knowing a little about every subject I knew a lot about one subject and very little about the others. This learning imbalance most certainly is a result of so much time being spent on learning the subject you are teaching and then so little time spent learning the others.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I would say that they were about equal: lecturing gave me a little knowledge of all subjects being covered and participating in group work made me a expertise in one subject but little remembrance of the others. What I would say that helped me the best was during clinicals, in our post-conference, our instructor would review topics covered and there with a small group of 5 students we were able to go over the chapters in the book and ask questions and participate in an 'interactive lecture' so to speak. During this time we would first learn the basic function of the system and then move to the abnormalities and before moving on, it was made sure that each of us understood the topic of discussion. If came about that one of us did not understand then all of us, their peers would explain their question. Our instructor would step in only if we were teaching wrongly or if there was more to add. This coupled lecture with group learning and I learned the most during these short sessions than I have in my entire college career, for I understood all of the material well.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I would have to say that I liked group work the best but only because it got us out of our seats and the day went faster, yet this is heavily shadowed by the fact that I had so much learning that I then had to do on my own afterward that I almost would choose lectures.

5. Please feel free to add any additional comments.

Participating in a small 'interactive lecture' with my clinical instructor proved to be the effective way of learning for me as it combined short lectures with questions and group teaching and learning together.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

   I enjoyed the idea of a concept map, but did not enjoy working in groups on the concept maps. It seems as though when you put a group of students together to complete a project, people are easily distracted from what they are supposed to be doing. Even though I, personally, am a leader when it comes to getting things done, it becomes a whole new project when others will not participate. Therefore, I would rather work as an individual to do such a large project.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

   I enjoyed working on the concept maps if everyone in the group was on task. However, I did not enjoy teaching each other about the content on the concept maps because each person presenting basically read off of the concept map that they made. In addition, what each student read was directly out of the book. I would rather spend more time reading the book and listening to a lecture that elaborates on the book's content.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

   I was able to retain more information for the exams when listening to a lecture that elaborated on the book's content. For example, if we were going over the topic (which is on the outline) and the presenter elaborates to the point that you can write your own definition and your own manifestations. In addition, it is easier to remember things once you write them down. It is not beneficial if someone reads lecture notes word for word, which is word for word out of the book, basically because you are not writing down any extra material to help you remember the topics. Group work only allows you to learn that specific topic and not all of the other ones.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

   I prefer straight lectures that elaborate on the material rather than just covering the book word for word. This helps me learn, allows me to write which also enhances my learning and gives me something to review later. Group work does not stick in my mind because it feels as though no one is really doing what they are supposed to be doing. In addition, the group work on the concept maps only comes from the book so it would be more beneficial reading the book.

5. Please feel free to add any additional comments

   I am definitely happy I got to know you better than I thought I would. It was a great semester and I look forward to more classes working with you.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I really enjoyed working in groups because I felt as though everyone got a better understanding of their subject when the students taught eachother. It was helpful too that you walked around and helped us all elaborate on our concept maps to help other groups understand our concepts.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

Yes, I do feel that teaching the concept maps to the other groups helped me with my understanding of each concept. Reason being is because I feel that when I explain something outloud, I better understand it myself. Also, it was helpful to have my peers teaching me because I felt like they were learning it at the same time as teaching it. It is always a good feeling when you start understanding how things work!

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I feel that both helped me retain information. The reason being is because you are really excited about the subjects you teach and that really helps me want to learn the subject. Both helped, but group work is always a great way to change things when the class has ptosis!

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I prefer cardiac and GI because I enjoy those subjects more and I feel that we elaborated more with the GI and Cardiac because of group work. Repitition helps!

5. Please feel free to add any additional comments.

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1. I really did enjoy the work on the concept map, while I was doing them I thought that they took too long and that I wasn't learning enough, however after the fact I realized that the majority of the information I remembered from this class was from the group projects and concept maps, I enjoyed splitting up and teaching our posters as well.

2. The concept maps I feel were helpful I liked that we split up into groups to do our discussions and teach each other about our posters,

3.I feel that the majority of the learning in class should be done through active class participation, the lectures were very interesting, however 4 hours of any person no matter how interesting gets hard to pay attention to, I thought that doing some case studies would be helpful as well as maybe guessing what our "case study" patients had, e.g. give s/sx and we can diagnose and say what we would do.

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1. Yes, I did enjoy working on concept maps. I think it really helps get the holistic veiw of a topic, and also really helps you see conections that you might not work out just hearing about it or reading it. I used a concept map for my pathophysiology portion of my clinical write ups and it really help me see how one disorder causes, or contributes to another.

2. I thought that teaching my concept map to others helped me, because I had to understand it to be able to explain it to other people. Unfortunatly, I did not learn well from the other students teaching me their topics. It is not that they didn't do a good job, I just had a hard time making myself concentrate in that environment. I didn't like presenting to the class as a whole either, it allowed you to only learn the part you where presenting, it didn't force you to learn the enitire subject.

3. I always felt ready for the exams on the subjects that I actually researched for the group work, especially when we then went over it in class as a lecture. The group work introduced the topic and gave me a general knowledge base, and the lecture filled in the blanks. Also, it was easier to fill in the blanks from the lecture because i was already familar with the topic.

4. I prefered cardiac and GI, although I really liked the neuro lecture. During clinicals I found that I was able to recall cardiac disorders and GI disorders and provide better teaching to my patients than I was with respiratory. Also, I think that the concept maps put things in a more user friendly format, I don't think being in a group really made as much diffrence as just the activity. I probably remember more about the cardiac, again I think it was because of the concept maps really simplifying things and allowing you to piece things together without straight memorization.

5. The online quizes really helped this semester, it just help put my mind in the right place and let me know the kind of things that would be asked on the tests and how I am supposed to be looking at a situation as a nurse. Thanks for a good semester, good luck on your project!

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I genuinely did enjoy working on the concept maps. They made class go by quicker and made class less boring! Not that lecturing is always boring, but we were able to get up and move around so we were more alive. Also, it meant we could converse and obtain other students insight on the content and the different ways to understand things. The concept maps reinforce the types of things we need to know and really gave us a way of thinking (i.e. this leads to this and then I do this). Not to mention the heart failure poster helped a whole lot on the test!

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better?

It did help to understand and remember things. We all think differently so when I would hear something I thought was funny or weird it stuck in my head. It also helps to visually divide the parts of the map up an to listen/see the way they relate.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

The number one thing that helps to retain the information was the anecdotes/ stories to remember things, like the crazy couple for the dysrhythmias. The group work was really helpful because it allowed me to focus specifically on the one disease for a while, so the focused aspect of group work was useful.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

Group work most definitely! This way I was not always distracted or almost falling asleep. I did better on the tests this way and it was way more fun! **However**, I will say a good balance between the group work and the lecture is amazing. The Cardiac Unit is the perfect example. You lectured on everything and then focused us on common disorders so we were able to really understand them. I remember a lot about the cardiac unit because we spent more time on it, using both the group and lecture work, allowing it to sink in and stay!

I remember several of the clever ways to remember Cardiac information, more so than the Respiratory information.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I really enjoyed working in groups on the concept map because it allowed us to use our creative side. We also get restless and chatty during lecture so this allowed us to talk and learn at the same time.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I felt that working on the concept maps and then teaching each other the content helped us learn the material better because it incorporated many forms of learning. We had to read the book to get the information, then we rewrote the information on the poster in a simpler form, and then we taught each other. I felt like I got the information reinforced three different times. I also like that we taught each other in smaller groups. This is less intimidating than teaching the information to the whole class. I found every aspect of this activity to be helpful to my learning of the material.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I tend to learn better when I see concepts visually, so doing the posters in a group was most helpful because I could imagine the poster during the exam. But when listening to lectures I tend to retain information better when it is related to a story that I can think back on during the exam.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I prefer the group work because as I have said it provides at least three different ways of learning, it gets us out of our chairs, and because I am a visual learner, I can imagine the poster later while I am taking the exam. At this point in time, I feel like I remember more about the Cardiac unit because I learned the concepts in three different ways while doing group work. I read about it in the book, put the information on a poster, and then explained it to my classmates. With the Respiratory unit, I only heard it in the lecture and skimmed my notes.

5. Please feel free to add any additional comments.

I found the group work to be very helpful and hope that it will be continued in the future!

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I really enjoyed working in groups for the concept maps. Not only do people learn better by teaching, but it was a lot more interesting that just sitting around in class and listening to lecture. It does have it's disadvantages though, and they are; sometimes not everyone pulls their weight, and inversely, sometimes some do too much work almost preventing others from participating, as the make others feel that their ideas just aren't good enough.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I definitely felt that teaching each other the material helped me learn better. It was helpful because by playing an active role in creating my concept map with my group, I learned the information, and than by teaching the information to others, it helped reinforce those concepts. What wasn't helpful about this experience was when others would just simply read off their posters and not add much. It made me feel as though it was a waste of time teaching, as I could easily go through and read the posters myself.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I can usually learn well from listening to lectures as I choose to take a more active part in my education by answering and asking questions, so even if lectures were all we had, I still feel that I would have learned the material. I did like the group work though, for all the reasons I have previously stated in the other two questions.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

It is hard for me to tell which I prefer because they were both so different. I am used to straight lectures, thus I am able to learn that way. I enjoyed the group work, but it is also a time to hang out with friends and not devote 100% of your attention to the assignment.

5. Please feel free to add any additional comments.

I really have enjoyed this class, and all that I have learned through it.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

One great thing about working in the groups was that it was easier for me to concentrate for the entire 4 hours as opposed to the lecture. However, our group was not always on task and chatted a lot, which is probably why I was less board. Also, since we did the exact same thing each time we did group work I did find myself rolling my eyes when we had to do the group projects.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I found that I learned so much about the topic that I was specifically assigned to. In fact, when I came to those topics in my studies I found I hardly had to study them at all. However, the other topics that the other groups taught to me were not as good. I found that some people simply are not good teachers and would find myself feeling more confused after I left them. The other problem with students teaching me was that I found I had a lot of questions and they did not have the expertise to answer them as you would have had.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

As I said above I retained the information from my own topics in the group work very well. Other then that, I am a very visual learner. In both the lecture and the posters if there were pictures of how things went I retained it better. For example, in the heart failure poster there were arrows showing the back flow of the heart into the respective organs, and I remember that very well.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I probably preferred the lectures for several reasons. First of all you were a very entertaining lecturer and I enjoyed what you had to say. Secondly, you were able to answer questions and explain them much better then my peers who had just learned about this topic 20 minutes ago.

5. Thanks Allison, it was great learning from you.

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1) I did enjoy working in groups for the concepts maps because it was a much needed change in atmosphere as opposed to the usual lectures.

2) Working on the concept maps and then teaching the content to others was somewhat helpful in understanding the material. I felt that the full understanding of the material was only if I was the one explaining information to another individual. For me personally, I had difficulty really understanding the way other students tried to present the information and I'm sure many others may have felt that it was difficult to understand the concepts others were trying to teach.

3) Having to learn the information for myself and then explaining it to other students helped me better learn the material. It seems the added responsibility of having to teach others really pushes people to completely understand concepts.

4) I preferred some group work as opposed to a continuous string of lectures just for the change of pace and a new way of gathering information. I also feel that the poster/concept maps helped me better organize the information.

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1. Did you enjoy working in groups on the concept maps? Why or why not. There were some things that I liked and that I didn't like, but I would say overall I wouldn't want to do them again. I felt that it took more time than necessary to do them. I also think that some people weren't active participants, but since we had a time limit of a class period we couldn't make a stink about it and felt we had to get it done with or without everyone's participation. I liked teaching our class mates but I wish that we did them as a group in front of the whole class because when you walked around and added your comments, which are very insightful, not everyone got to hear it.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. Like I said above, I liked teaching the material to other people, but if that person wasn't an active participant we didn't get a good learning experience since that person didn't know what the heck was going on. Some people are better teachers than others and others add their own input without, maybe, not knowing the whole truth which gets confusing. I would have liked to present in front of the whole class so everyone got to hear the side notes that you commented on. For example: I over heard you talk about the MONA to one group, and in class you asked a question on the steps you would take for someone coming into the ED with CP. I knew the answer only because I over heard you telling one group.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? Personally I think that you are a great teacher and lecturer. I would rather listen to you than do concept maps and be taught by someone who is a poor teacher. If everyone in our class were enthusiastic and a great teacher, I would love concept maps, but that's not the case and I got more out of listening to you lecture.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why? Straight lectures. At the level that we are learning, all systems get complicated and without a good teacher/mentor it is hard to learn from classmates teaching us without prior knowledge on the subject. I felt the information was choppy because we didn't quite know all the material we should have known and sometimes it was confusing what the "teacher" was trying to get at in explaining. When I study, however, it is helpful for me to have taught that specific part and retain that information.

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1) I think that working in groups, making the concept maps was a nice change, and allowed for more interaction with the class.

2) I liked the concept maps because they gave us something other than lecture to participate in, and was just something different than the usual day to day stuff. It also made me feel more comfortable with the subject that I read up on and taught, but didn't do a whole lot for me in the subjects that I hadn't made a poster for. I didn't like the concept maps because people were just repeating exactly

what the book said. Plus I would rather receive my information from the teacher and know that what I am being taught is correct and not some educated guess.

3) I can't really say that I enjoy being lectured to, however, it does seem to be the most beneficial to me when it comes to learning the material. In lectures, it also helps to have a lot of pictures available so that I can see what we are talking about. Also the teacher can elaborate on subjects she deems worthwhile, which can't really be done with the group concept maps. The concept maps were helpful for me like when we had heart failure, and our group had to draw left vs. right sided heart failure. For some reason the picture has really stuck in my head, and made it easier to learn the following material.

4) Overall, I preferred the straight lectures of respiratory and neuro, because I was given the correct information. All the info was put in front of me, categorized into sections (which helps me categorize them in my mind), and we were able to expand on some subjects, and skim over other areas that weren't as pertinent. However, I can recall cardiac pictures both in the book, on the concept maps, and on the lecture slides, that really help me to organize all the information in my head and understand the heart a little more.

1.) I did enjoy working on the group concept maps because I was not only getting to know others in my class, but I was able to learn a few things from their knowledge. However, I may have learned more if I were to do the whole map on my own because I would be studying all of the information and not just one section.

2.) I was able to understand the map best when I taught the other students, but I feel like I didn't learn as much about the other topics. I liked looking at the pictures and maps for visual learning, but I didn't put in the extra effort to review the other groups' topics outside of class.

3.)To help me retain understanding of the information, I liked both listening and groups. Learning from multiple forms helped me review the overall concept of different topics. The more times I reviewed the material, the better!

4.) Once again, it was beneficial for me to do both straight lecture and groups. My attension span becomes short with lectures, so switching to group projects gave me a new form of learning and applying.

5.) I also liked your creative ways to help us learn the material such as personal stories, the music video, or the rope representing the intestines.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I thought that there were advantages and disadvantages of working in groups and making concept maps. Working in groups allowed us to actively engage with each other by discussing the subject matter, teaching each other, and helping each other to better understand the material. Making concept maps helped us to organize, prioritize, and pick out the important information. Teaching our subject to the other groups reinforced the information and forced us to learn the material. On the other hand, it was sometimes difficult to focus when working as a group. We weren't always sure if we were getting the main points out of the topic and accurately understanding the information. I'm not sure if teaching each other was as effective as learning the information in lecture.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

As I mentioned earlier, making concept maps and teaching each other helped to reinforce the information into our heads and forced us to learn the material. I'm not sure if teaching each other was as effective as learning the information in lecture because we may not have covered all of the key

points of the topic, taught the information clearly, and weren't always able to answer each other's questions.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

When I hear about real-life situations or experiences related to the disease or disorder that we are learning about, it helps me to retain the information. When participating in a group, discussing the subject and hearing different input and perspectives about the topic helps me to better understand the information.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I personally prefer straight lectures because I am somewhat of an auditory learner. Lectures also allow me to add side notes to the lecture outline. Doing group work helps me to learn my group's topic really well but not the other groups' topics.

5. Please feel free to add any additional comments.

It was really neat to relate and apply what I learned in this class to the clinical setting.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

Yes, for the most part. I feel like it really helped me with the particular topic that our group had. Sometimes, the other groups posters weren't not as good of a learning experience since we are going through them all at once, but they were a bonus help on the tests!

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

Kind of the same answer as above... it really helped me to learn the topic I had for my poster, but the learning curve was not quite as high for the other groups posters, though. It was a nice change in the schedule sometimes.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

It helps me to take notes and ask questions during lectures. And in group work, it helps that we can do research together and then talk about it as a group, also asking questions of Alison.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I definitely prefer lectures to group work because Alison knows way more than we do and I like her to describe all the subjects to us and allow us to ask questions so I can just sit back and learn and take notes. Although group work was a nice change every once in awhile, I felt like I would have to go back and reteach the other groups subjects to myself because they were not able to describe it as well as when Alison lectures.

5. Please feel free to add any additional comments.

I loved when you would answer the questions we had about our subject for our poster. I know it would be tough, but it would be neat if you could somehow be at the units more as the groups were explaining in order to answer questions or add additional information that you thought would be necessary for us to know.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I did enjoy working in groups making concept maps because we were challenged to read and understand the information and then interpret it and re-create it. This really helped me learn about the subject because I was actively engaged. Also, because we worked in groups we were able to explain the concept to eachother and help each other understand the process. Also, like you told us, by teaching something you learn it too. I totally believe that now. First off, you have to understand something to explain it to others and then when you teach someone else you are actively engaged in the content and by repeating it, it starts to sink in.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I guess I kind of answered this question above but again, yes I feel it was helpful to teach the material to others because you must understand it first to teach it and then you are engaging your mind when you are teaching others about it. I feel like I learn much better when I am actively involved. I know that when I taught, I might not have had the answer to every question but we looked it up or asked you and we all learned something together.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I don't think I learn as well by listening, it is just not my learning style. When listening I would have to follow along on the slides to really retain the information. I think I learn more visually, by reading and looking at diagrams. I also learned better when making the concept maps and working with others because we discussed the material and created a visual learning tool. I feel I learn better when I am doing something, be it duscussing or drawing a diagram.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I prefer group work for the reasons discussed above, I feel I learn better when I am actively engaged in the material. Also, working with a group you have different individuals who may view a concept differently and may be able to explain it in a way that is easier to understand.

I feel I remember more about the cardiac unit. First, because we did the concept maps and then taught the material to the class. Also, I work on a cardiac floor at the hospital so I started to put bits and pieces together that I had seen at work and with the material in class, I was able to make sense of it. I feel too that we rushed through the respiratory unit and because it was just lecture, I don't feel that I retained as much material.

5. Please feel free to add any additional comments.

Even though I liked group work better, you did a great job at making lecture material interesting and fun. Thank you.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I enjoyed working on the concept maps because I got a better understanding of the topic my group was working on. It was also interesting to look at how people drew concepts to help get a better view. At the same time, I felt like I didn't learn as much about the other topics.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I felt I learned my topic more thoroughly, especially reading about it in the text and then explaining it to others. I didn't think it was the best use of our time to divide into separate groups and rotate around to different posters, and then lecture afterwards. I think it would have been helpful to have the entire group stand in front of the class with their poster. That way, the whole group could provide input about the subject, the class could benefit from each other's questions, and then Alison could provide the additional material that was covered in the lecture.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I feel I learned more from what we covered in lecture. I retained more information when actual case studies from clinicals and real-life situations. I also liked the examples provided for the EKG leads, because I had a small packet that I could review. In doing that, I wanted to learn more about the cardiac system and the different ailments that can change EKG readings.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I would prefer a combination of the two, so we could teach each other as well as get the information from lecture. I liked having group work alternating with lecture, because I felt I leaned the information better if I sort of switched gears. It helped me keep focused on the information I need to learn.

5. Please feel free to add any additional comments.

Alison is an excellent teacher because she is willing to teach different ways in order to help us understand concepts. I think this is a great way to keep us interested in learning the information! She also enjoyed using sounds on her power points, especially during the GI system, to make sure we were still awake. ☺

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I enjoyed working in groups on the concept maps. I felt that it made me research and know one chunk of information very well. I felt that it was helpful to sort through all the unnecessary information and pick out what is important and then organize it in a succinct fashion on a map. It was also a nice break from straight lecture.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I feel that teaching others about the content I learned was helpful because I had to explain it and not just read out of the textbook or absorb information. I truely had to understand it. I don't feel I learned very much when everyone else taught us their information. Many times I couldn't really tell what was important for me to retain because when someone lectures, they usually talk about what is important

and we just read a lot of information and try to pack it on the papers. You also know that the other students do not speak with a great amount of confidence or credibility because our only exposure was the textbook for about a half hour.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I retain information best when it is presented in stories about patients that you have had. Case studies are still very dry and don't help me retain very much, but actual stories from experience stick with me somehow. I also remembered the heart blocks well because of the stories and youtube.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I prefered straight lectures because I feel that with group work, I only learned one topic well and the rest of the information did not get retained at all. I feel I learned more from straight lectures and it was a more effective use of our time.

I remember the Cardiac unit pretty well. I remember quite a few of the pictures on the posters because I am a visual learner. I don't know that I remember more detailed information about the cardiac information, but I think that I remember more general concepts from the pictures and clearly outlined information.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

To be completely honest I don't really like group work in general. It seems to me that in every group there is the always a couple of people who end up doing all the work. But, on the positive side, it was fun to really get to know one topic and be familar with it before studying.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

It seemed to me that it made me know my stuff as far as explaining my topic but I often times had trouble focusing when others were sharing. Lots of times it was just a ton of jumbled information on a poster, and it was hard to really get the big picture and what I truly needed to know and understand.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I am a very visual preson so it really helps me to have pictures when learning the lecture material. Also, the more interesting the subject the more it seems to stick (i.e. Heart blocks). I really liked the senerios of the couples, it helped me immensely in keeping them straight in my head.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

Personally I prefer straight lectures because I feel like in lecture I get all the material I need to know first hand rather than learning it myself later if it was not presented in the groups.

5. Please feel free to add any additional comments.

Thanks for doing such a great job of teaching us. I really enjoyed learning from you!

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1. Did you enjoy working in groups on the concept maps? Why or why not.

I enjoyed working in groups on the concept maps because is gave me an opportunity to talk to other classmates about material that was unclear. It was also nice getting someone else opinion about the material.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I thought I learned more doing the concept maps and then teaching each other because it gave me more of a visual in my mind which helps me retain information better. It also was fun environment making it a better learning experience for me.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I do better on test when I listen to lecture because it makes me concentrate on specific material better.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I prefer lecture because during lecture I am more focus on the information that is present.

5. Please feel free to add any additional comments.

I thought Alison did a wonderful job teaching. I learned a lot from her because she really explains the material. She made the lecture fun and interesting.

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1. Did you enjoy working in groups on the concept maps? Why or why not.

Yes, I did enjoy working in the groups on the concept maps because I learned very in depth information about one specific area. I also liked it because it was a change from lecture in which fellow classmates were able to interact and teach each other. The change is nice because I get bored of just sitting in class listening to lectures after awhile.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I think that I learned the material more indepth than if it were just covered during lecture. Teaching other people definitely helped me understand and want to understand the material better. The concept maps helped me understand the disease pathways better. The content that you choose to do the concept maps was good because there was several different but related subjects.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

Talking it through and asking lots of questions about the material helped me retain more information. I noticed that when I would present on a subject that I would explain the stuff that I had questions about because if I have a question more than likely so does someone else. It seemed that in most groups the presenter would cover the material more indepth and explain concepts in the same way in which they were able to understand them.

4. Did you prefer straight lectures (Respiratory, Neuro units) or group work (Cardiac, GI) and why?

I preferred the group work because I felt like it was more indept, but I think it would be very difficult to convert the neuro unit into group work. I would prefer the neuro unit as a lecture. I can really

remember the Cardiac unit...I think mostly because it was a different style of teaching. I can still picture the posters and presenters, but I cannot remember the respiratory unit in the same way.

5. Please feel free to add any additional comments.

I enjoyed the group work, but that also seemed to take a long time.

Appendix G: On-line Qualitative Responses

Second-Degree Cohort

1. Did you enjoy working in groups on the concept maps? Why or why not? *Yes. I like to be creative and it helps to talk over ideas with a group. It was a nice break from having 4 hours of lecture.*

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. *When creating the concept maps, you had to pay attention so that you would be able to teach the material. The only downside was that occassionally the presenters did not know the information. So it was helpful to review it again in class during lecture.*

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? *I am a visual learner, so it helped to see a disease process mapped out on paper.*

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? *I prefer doing group work. I think it is hard to sit for 4 hours, so breaking up into groups allows things to be more interactive. Lecture is also helpful. Ideally, doing both worked best for me.* I remember the *Respirator unit. I can still picture the concept maps in my head with the "pink puffers" and the pulmonary toilet pictures!*

5. Do you have any additional comments you'd like to add? *Nope*

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1. Did you enjoy working in groups on the concept maps? Why or why not? I did enjoy doing the concept maps in class, this was a good way to come up with creative ways to remember the information.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. The teaching of the information to other students did help to "cement" the material in my mind, and then reviewing the info in class during lecture helped even more.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? I also enjoyed listening to the lectures, as Alison has real-life experiences that help us to be able to picture the topics when she tells us about situations that she has had occur.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? I actually prefer the group work when it is followed up with a brief review during lecture. Both ways actually bring the information to life, but the combination is what I enjoyed best.

5. Do you have any additional comments you'd like to add? This class had a lot of information in it, but overall it was organized and presented very well.

Did you enjoy working in groups on the concept maps? Why or why not? This was not my favorite part of class. I didn't learn as much from the concept maps as from straight lecture. It is better for me to hear the material and add notes to the power points than to work with others to draw a picture.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful

about this experience in terms of learning. It was helpful for me to learn the material that our group did by teaching it to others. However, many of my classmates, myself included, are not the best instructors. As a result I often didn't learn much by moving around the room and hearing about the other groups' activities.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? I learn best by hearing the material presented, adding my notes to the power point and then reading the text and power point together. I have trouble focusing on the details in the group setting.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? I prefer straight lectures hands down. I will qualify that by stating the skill of the lecturer makes a big difference. If the material is presented in a way that brings it to life then I learn it well. I would go as far as saying I would learn the material better by reading the power point and text without any lecture than the group work.

5. Do you have any additional comments you'd like to add? One of the other responses said how they liked having different lecturers over the course of the semester. I generally agree, however, some lecturers are much, much better than others. It was also clear that some lecturers were just a page or two ahead of us in the book and didn't have a great deal of command of the material they were presenting. They didn't try to hide it and admitted as much. It would be better if in some cases the teachers were more knowledgeable about the material they were assigned.

Not surprisingly I am not a fan of group work. I want to hear the information from someone who knows it well and in-class research doesn't reach that level for me. I like to challenge information and feel as if I can thouroughly investigate any given topic. I don't mind learning from my classmates but I often cannot get questions answered. I am not a visual learner so the concept maps don't do much for me either. Having said that I feel more confident with the cardiac unit. However, when lecture material doesn't answer my questions I am forced to do my own research and I oftentimes learn that material better.

I think having multiple instructors is a good thing but I wish there was a way to get each of you to teach in areas that are your strengths, we would benefit greatly. You have been an amazing teacher and an even better role model of what professional nursing should look like. Thank you for that.

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1. I enjoyed working in groups on the concept maps, it gace us the time to sit down and talk to each other and we don't get a lot of opportunity to do that.

2. The only downside to this method is that if another group is not thorough or clear with the information they are presenting, it is not a valuable learning experience.

3. When the instructor shares specific examples of when they worked with a patient with that illness, i remember it easily.

4. I preferred the straight lecture because then we know exactly what to cover when we study for the exam.

5. Peds lecture always felt rather rushed and I don't feel like I learned as much about peds as I could have.

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1. Did you enjoy working in groups on the concept maps? Why or why not? Yes,

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. Working on the concept maps and teaching each other helped me understand the material better, because I seemed to remember the material better when I taught it, but the down side is I didn't seem to retain as much from the other groups teaching because I was thinking on how I will present and teach my material.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? I seemed to retain more of lecture especially your style of teaching.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? I think I preferred straight lecture than group work, but for some of the topics that you weren't teaching I would have preferred group work

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Did you enjoy working in groups on the concept maps? Why or why not?

I did enjoy working in groups on the concept maps because it was a fun way to learn the information and when it came time to take a test the recall of the information was from making the concept map instead of reading everything off of the notes. I also feel that teaching something over and over makes you remember it so much bettter so i really felt this was helpful.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

Well I feel that teaching was helpful in the sense of repition and allowing the "teacher" to learn the material very well, but when it came to being taught by some other students it became some what confusing because not everybody understood what they were teaching and made it difficult to learn about others concept maps. I feel that presenting it in front of the whole class in one big group where the actual teacher could watch all the time and make corrections or clarifications would be better.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

For me meeting with you helped because after learning the material in lecture and then reviewing things as the "whole picture" made sense instead of the material just being points on slides. I feel turning a lectur into a sort of concept map really helped.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

I perfered group work just because it forces you to listen and understand what your group is going over, rather than trying to pay attention to striaght lecture. .

5. Do you have any additional comments you'd like to add?

Thanks for being a great teacher, you enthusiasim helped me to understand the material and remain engaged during your lectures and I feel you make the material relevant you find fun ways for us to learn.

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1. I think group work is fine however I don't really learn anything that way. I learn a lot about the subject my group researches but it is harder to learn about the other subjects.

2. It might be more helpful if we prepared a day before on the subject. We end up skimming through the book quickly to fill in our concept map. The concept maps are probably not as complete as they

should be. It is a good way to learn about the one subject your group is assigned to, but teaching each other is not helpful to me.

3. I learn best during lectures that go beyond the Power Point slides. Hearing about actual patient care and nursing priorities also helps me in exams.

4. I prefer straight lectures. I always worry that I am not getting all the information in group work. Then I feel like I do more work trying to fill in the gaps. I am more confident with a lecture that what is on the test will be covered.

5. I understand the purpose of getting together in groups and studying material for class. It does help break up a full day of lecture. However, we never get all the information and we miss out on our instructors point of view on how the particular disease or problem presents in real life. It is also harder to ask questions in a group teaching experience.

_**1. Did you enjoy working in groups on the concept maps? Why or why not?** Personally, I am not a huge fan of working in groups on the concepts maps, just because I seem to be able to focus and learn more from lecure. Group work and concept maps were somewhat helpful, but just not as helpful to me as lecture was.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. Again, since I feel like I get more out of lecture, working on the concept maps and then teaching each other didn't seem to help me gain a better understanding of the material more so than lecture. I think that perhaps if I and my classmates had time to read the assigned readings before class, and had a stronger understanding of the material before the concept map was made, perhaps I would have gotten more out of it. It just seemed like we all were teaching ourlselves these topics in a crammed amount of time, and I ended up with more unanswered questions or unclear explanations than I would have with lecture.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? An engaging lecture style and taking notes from input given other than just listening to the lecturer read from the slides helped me retain information.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? Again, I am a fan of straight lectures, because I liked getting accurate information explained in an organized manner from the "expert." I thought the cardiac lecture was great, especially the memory aids given by Alison for learning the strips. It seems like I had to spend more time on my own going over things when they were only covered in group work.

5. Do you have any additional comments you'd like to add? Overall, it was a great class, and I thought Alison was an amazing lecturer who I learned so much from.

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1. Did you enjoy working in groups on the concept maps? Why or why not?

I enjoyed parts of the group work. Some folks had interesting stories or different ways of remembering information that was helpful sometimes. It was also nice to have a break from straight lecture, although I would probably prefer that overall.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

The fact that we all look at the information a little differently and have different experiences was helpful when doing group work. I also liked having the opportunity to practice presenting information in front

of a group since I don't do that as much anymore. In addition, if there were questions I had that weren't answered, I could look that up later and I felt I learned that subject a little better from doing so.

I think the less helpful parts was that we didn't really know the material and didn't have much time to learn it before coming up with the posters or presentation.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I honestly can't really say. In both cases, maybe I can say that the combination of hearing and seeing information helped me to retain information more.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

I honestly prefer straight lecture most of the time because it is usually more structured and I can focus on the information and how I want to structure that in my own mind, rather than trying to figure out how 5-6 different people are going to be represented on a piece of paper.

5. Do you have any additional comments you'd like to add?

I appreciate the effort to accommodate different learning styles more this semester than I have in the past. We had lecturers remove nearly all of the pictures, had text filled slides, didn't have interactive presentations, etc., so it was more clear to me this time around that maybe not all students are being given the information in the most beneficial way. And while I may prefer lecture overall, I certainly see the merit in doing the group work too and wouldn't want to see that lost.

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1. Did you enjoy working in groups on the concept maps? Why or why not? I enjoyed the break from lecture, although, depending on the teacher, it is not always more conducive to learning vs. another teacher. I would always prefer lecture if you are teaching.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. Yes, I do think it helped us to retain the information better, but unfortunately only on the subject we worked on.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? I enjoy the stories and/or acronyms that help us to retain or relate the information to real life. It has seen shown that topics or learning that incorporate emotion, is better learned. You have an incredible gift to present in this manner! Thank you.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? Straight lecture for the reason's stated above.

5. Do you have any additional comments you'd like to add? Your lectures are stimulating, energetic and insightful. I would always prefer your teaching method to any others we have seen.

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1. Did you enjoy working in groups on the concept maps? Why or why not?

In the words of Randy Jackson from American Idol, "It was just OK for me". I definitely didn't hate it, but I feel like I would have learned a LOT more if you had just lectured instead. It was a nice change, but I like your lecturing style so much, I know I would have absorbed more if you

had just lectured on the material. I kinda wish we would have done the maps for a different lecturer.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I think that teaching eachother the concept maps was definitely a lot better than NOT teaching them. It was nice b/c it made us feel like a "mini expert" on the subject because we knew so much about it after learning the topics for an hour or so, then we got the opportunity to teach it; I did like that aspect of it. It helped me retain my topic better, but NOT everyone else's.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

Honestly, just having you as a lecturer made it easy to listen and learned. You have a way of making it "click" and you connect all of the dots, if that makes sense. I learned SO SO much more when I was listening to you as opposed to the other lecturers. I feel that I will remember a lot of your stories for a really long time. They help to apply the lecture to the real world, and that was one of my favorite parts. It just seemed so much different when you lectured, and I can't REALLY explain why. Others would just read EXACTLY what was on the slide, and it's like "what's the point"...of coming to class that is.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

I prefer straight lectures if you were the lecturer. I prefer group work if someone else is lecturing. As stated above, I learn much more when you lecture. If we did group work with a different lecturer, it would have motivated me to come to that class instead of dreading it.

5. Do you have any additional comments you'd like to add?

I know that I have been pretty harsh on the other lecturers in this post, but it's only because I want you to know that their teaching style is no where near yours. I don't really think it's a learning preference issue either, because a lot of people in the class all agree. Whenever we had someone else, we couldn't wait to get you back. Most of them really do just read off the slides and add A FEW comments in here and there; to me, that's not a good way of lecturing. Alison, you really are a FANTASTIC lecturer and I wish we could have had you the whole time for med/surg.

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1. Did you enjoy working in groups on the concept maps? Why or why not? The concept maps were a nice change of pace from straight lecture and I think they were beneficial however may have been more beneficial if we were expected to come prepared to develop it and not spend time researching during class time.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. I don't think teaching it helped me to learn the material better but developing it and seeing it on paper in a different way is what helped me the most.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? You are obviously a spectacular lecturer and I think it is hard to have others who may not be as exceptional as you. It is very unfair for us to judge and compare them to you and I tried not to but it's hard. In some cases, it almost seemed as though some of the lecturers

were expected to teach from other's materials (ie. ppt slides) and it seemed more difficult for them and made it more challenging to learn. Not sure if this was the case but just an observation. It was hard for me to have several lecturers for one class...I felt as though I had to change my study habits and the way I prepared for exams each time we had a new lecturer and it was uncomfortable.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? I like a little of both. I am a visual learner as well as I need to experience it. Caring for a patient and connecting it to a topic in class was how I really learned.

5. Do you have any additional comments you'd like to add?

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1. Did you enjoy working in groups on the concept maps? Why or why not?

I enjoyed working in groups to an extent. I felt like we ending up wasting more time than necessary by waiting for other groups to finish, etc. I liked working in groups because I learned more while I was researching the topic, but when I went around to the other groups to learn about their topic I didn't feel like I learned as much. I liked how you went around from group to group to answer our questions.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I think I would have understood the material better through your lecture. If it was a different lecturer vs the concept maps, then I would say the concept maps would be better. Your lectures are the best, though, and I don't think the concept maps do a better job at all. I do like having variation in the day and having the opportunity to walk around and talk with people. The concept maps were helpful when the other people in the groups learned their material and taught it well, but if they didn't then I felt like it was a waste of time.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I really liked during your lectures when you made something funny or made us think about something differently, like the heart blocks. When I was able to link a picture or joke you said it was easier to remember the topic. I honestly can't remember anything in particlular about the concept map material, so it didn't help me retain information very well.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

With you as the lecturer, I enjoy more lectures and maybe a few group work exercises. If it was a different lecturer then I'd probably say the opposite. I felt like I listened more intently to you and that I didn't fall asleep in the first 10 minutes of lecture. I don't have a very long attention span, but you were able to hold it for the entire class. Group work sometimes made me feel like I could be doing something else more productive. I definitely remember more about the cardiac unit. I can still remember the stories about the heart blocks, and I was able to visualize the heart and all of the disorders. I can't remember much about respiratory right now, except the topic that my group studied.

5. Do you have any additional comments you'd like to add?

I love your lectures. You do an awesome job, and we all definitely felt a loss when you left to lecture the other class. The class attendence drastically dropped because we all felt like we weren't getting anything from class when you weren't there. We were so happy to have you back for the neuro unit! I think mostly lecture and every once-and-a-while group work would be the best way to help us learn.

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1. Did you enjoy working in groups on the concept maps? Why or why not?

I thought working in groups improved my understanding on the specific topic I was teaching. It also helps to break away from lecture for a while.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I thought the understanding of the topic I was teaching greatly increases as a result of making the concept maps. I thought some students taught their topics well and some did not making you teach yourself later.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

I mostly like to teach myself from the textbook and notes. I've found I learn the material better.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

I preferred straight lecture because you hear the information from the same lecturer.

5. Do you have any additihonal comments you'd like to add?

no thank you

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1. Did you enjoy working in groups on the concept maps? Why or why not?

   The concepts map were helpful to me in terms of visualizing the disease process and learning from my peers expertise.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

   It was helpful if the person had a desire to actual teach the material. I found that my learning of the information depended slightly on how it was presented and whether the person wanted to be teaching the information

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

   The visual presentation of the material and reiterating of material is helpful to me. To hear the information twice and then study the information on my own was very helpful. I was able to retain more information from lecturing because the lectures were so engaging and visual.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

   I really enjoyed the variation between the two. Alison was great to listen to and I learned a lot from her but also the group work was a good way to teach and draw out the pathophys myself.

5. Do you have any additional comments you'd like to add?

   I just want to add that Alison's teaching style worked well for me in regards to her knowledge base and enthusiasm towards subjects at hand. I believe that she is the professor that I have learned the most from so far in nursing school because of her open, visual and "real life" lectures.

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1. Did you enjoy working in groups on the concept maps? Why or why not? I did for the most part. I really learned a lot from picking a disorder and filling out the concept map. I didn't like going around in groups as much, learning from other posters. Maybe because I am a more hands-on type of person, but listening to others teach didn't really help me understand the disorder too well. Some students didn't know much about their group poster, so that was frustrating. The first time we did it I didn't like the fact that it was the only opportunity to learn about those disorders in class. But this last time was good because we went around to each poster as well as had a lecture on those same topics. Getting the information twice, in two different formats, really helped me understand the material. Overall, it was a nice break from lecture. It is probably a personal preference, but I learn better from an instructor or others who really know how to teach a subject matter. Working in groups was good - especially since we were able to choose who we worked with.

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. I sort of touched on this in the previous answer. I thought working on the concept map and then teaching it really helped me know the information. I just didn't learn as well from other groups and I am not sure exactly why.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? Having an instructor tie lecture material to experiences they have. It helps me retain the information if I have a story or situation to relate it to. Having an enthusiastic and passionate instructor also makes a huge difference. It helped engage me in the lecture topic and material. Much easier to pay attention when the instructor makes it interesting and adds stories to enhance understanding and problem solving.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? I honestly prefer the straight lecture unless the group work is going to be taught by the instructor as well as the groups. I learn best by listening to someone who really knows what they are talking about, can answer questions, and can provide all the information that is most needed. In group work, I worried about key points being left out or not teaching my topic well enough for the other students to really learn and understand. I also like organization - lecture always felt organized :) I liked the neumonics you gave to help us remember rhythm strips and your teaching styles really helped the information stay. I also was most worried about that unit and I probably studied more for that unit than any other one. So that probably has something to do with it. But I still remember TB well from respiratory because that is the poster my group did. So I suppose those work!

5. Do you have any additional comments you'd like to add? I really enjoy clicker quizzes. I like reviewing material either verbally or through practice quizzes in class. The only frustrating thing about review in class is that there is always one or two individuals who call out the answer before anyone else can even think about the answer. That was the only thing I didn't like about in-class review. I felt as though I didn't have time to test what I knew and remembered. I also enjoyed taking those pre and post-tests. It helped me see what i have learned and areas I still needed to work on. Overall, I thought it was a great semester and appppreciate all your help and guidance.

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1. I did not enjoy the group work. I think that it was very helpful in learning the topic that you had to teach, but was not helpful in learning the other topics. I felt like I needed to study the other topics a lot, much more than I would have if you had lectured on them.

2. I do think that doing the concept maps was helpful for understanding my topic. I think that it was helpul to have to look up the information and helpful to write it out and make visuals to help it make sense. I think that I learned more when I was the group member actually writing the information. Sometimes everybody is putting in so much input at once and it is hard to learn it all when you are not the one writing.

3. I think that you are a wonderful instructor. Your lectures brought the material alive and made it much easier to understand. You have alot of stories that put pictures of things in my mind and help me remember them. I also loved the different tools that you used to help us remember hard concepts such as acidosis and alkilosis and the heart block family. I think that overall you make things so much easier to understand. That is why I prefer your lectures over the group work. I feel like I am missing out on so much when I do not get to hear you teach it.

4. I preferred straight lecture. See #3

I preferred straight lecture, rather than doing the posters. I think we spent too much time working on them when we could have been listening to your lecture and and learning more. Out of every class I've taken in college, you're the best lecturer I've had. I think the posters would have been okay when we had other lecturers because I tend to wander when all the teacher does is read word for word from the slides and comes in without much enthusiasm. But, I don't think the posters were a waste of time. They are kind of fun and it helps us get to know other classmates as well.

Whoops, I accidentally posted that too early. 2.) I think teaching eachother after working on the maps was helpful because that made us remember our own topic, that way everyone benefits from it. I think it also helped breaking up into groups because that put each person from the group on the spot and made them responsible for participating initially. 3.) I've learned best by listening to your lectures, especially when you review the material at the beginning of the class from what we had learned the previous class. Also when you act out examples, I remember those a lot. Mostly becuase it's funny. I also like that you don't just read your slides, I've found that on each lecture you've given, I have many notes that I've added myself and when the other teachers lecture, my page is blank. 4.)I like straight lectures more, but I don't dislike the group work either. I think sometimes it's a nice change to do group work. I do think that if we had cardiac as a group, I wouldn't have learned too much. I think respiratory and neuro are appropriate subjects to have as group topics because I think they are less complex. 5.) I remember more about cardiac because there was more content on this subject as far as patho and A&P. I do remember a lot about just the respiratory disorders though. 6.) I really wish you would have lectured on oncology, I've always been really interested in it and I hate to say it, but this semester ruined that for me.

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1. Did you enjoy working in groups on the concept maps? Why or why not? I enjoy working in groups for the most part. It is nice to see what others are thinking and their ideas. At times someone may have a better understanding of the topic than myself and can she some light on the subject for me. The only disadvantage is that the way we worked in groups is difficult to some extent, because I am not very creative.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. Creating the concept map helps me to understand the assigned concept better, but I feel it is more difficult to learn the other concepts as well as if you lectured.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? I am an auditory learner and to have quality interesting lecturer appeals to that portion of my learning abilities, I also take notes as the teacher lectures and that appeals to my kinetic learning abilities. You also tend to be very animated as you lecture and tell quality stories that assist in remembering the topic being lecture.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? It depends on the teacher, but when you are the instructor I prefer lecture over group work. This is due to the fact that I feel I do not learn the other concepts presented by other students as well as when you lecture about them.

5. Do you have any additional comments you'd like to add? No additional comments.

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1) I did not hate working in groups for concept maps but did not overly enjoy it either. I learn so much better by listening to the instructor and taking notes. Group work helps me learn more about maybe our groups topic but not the other groups topic.

2) I think it is very important to have a good instructor to teach the material. I was always disappointed when we had concept maps or other group work to do that day. I always felt that since I don't learn well in this way that it was a waste of my time. I enjoyed the way you taught the classes and a couple other instructors. At times when some of the instructors taught I felt I would spend better quality time at a coffee shop reading and learning the material myself.

3) When you taught, Melissa taught and at times Kat taught I felt it was valuable to come to lecture. When the instructor has a lot of experience and can relay their personal experiences with the topic it is fun to learn and easier to retain the information. I feel you also teach the class on a level that we all understand. Some of these topics can be difficult to first understand and the extra time the instructor takes to explain the topic is very beneficial. Again group work was never my cup of tea.

4) I definitely retained more information for the exam with a good instructor and straight lecture. No group work

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1. Did you enjoy working in groups on the concept maps? Why or why not?

Yes, I enjoyed interacting and working with my fellow classmates. Everyone has unique experiences and perspectives which help put the concepts in a real world context.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I am not sure I learned the material better by working with concept maps. I learn best by reading something and relating it to my own experiences. However, I found the information presented in the concept mapping sessions interesting. It was helpful to have visual representations of various conditions. The lack of expertise in the topic areas was apparent (myself included). I sensed that some people were frustrated because their questions couldn't be answered fully. It helped to have Alison available to answer more detail oriented questions.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

When Alison was the lecturer I retained the information better. I didn't get as much out of lecture time when there were other presenters. When topics are tied to real world experiences I usually retain that information longer.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

I preferred straight lecture. I feel like the topics are covered more thoroughly in lecture.

5. Do you have any additional comments you'd like to add?

I am glad that future classes have a stand alone pediatrics class. I felt like the pediatrics portion was an afterthought and right now I am not fully confident with all of the pediatric material.

1. I enjoy doing the concept maps but I prefer to work on them alone as opposed to working in a group. I am a bit ADHD and find that I work at a much faster pace myself and would rather get it done, then move on.

2. I felt working on the maps helped me learn the material, but I do not feel that I am a good teacher. I guess maybe I do not want the responsibility for someone else's failure or success. If I taught them poorly or gave them the wrong information, then I feel partly responsible for their failure.

3. Because I am very much an auditory learner, listening works very well for me. Discussing the concepts with examples from a lecturers own professional practice really helps me recall the details.

4. Because I prefer lectures and not group work, I preferred the cardiac and GI units better than the others. I remember more from the cardiac and GI lectures because I remember the information better if it is presented in a lecture format. However, this is not effective if the lecturer does not seem to be prepared, is using someone else's powerpoints, or has not adequately reviewed the material prior to presenting the lecture, then it just makes it much more confusing and is not helpful at all.

6. I don't really have anything else to add. I believe everything was covered in the previous questions.

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1. Did you enjoy working in groups on the concept maps? Why or why not?

   I did enjoy working on the concept maps together as a group because it allowed us to pool together our knowledge and understanding of the topic, however, I think it would have been more beneficial to pick the topic and then be allowed to research it that night and to present it to the class the following day. We would have been able to make more detailed concept maps and have the chance to more full understand the concept before presenting it.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

   Once again I would have liked a little more time to fully research the topic so I could have made better sense on my concept maps plus this would have allowed us time to fully understand the topic so we could better teach it.

   I believe one always learns better once they can fully teach that subject to another.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

   I think listening to the lectures gave us the basics of what we needed to focus on for the exam and gave us a general over view. I particularly liked when the lecturers told us relevant stories this helped me during the test because it triggered me to remember certain things. Group work was good in that it helped us learn the particular topic we presented on but it was hard for me to remember what others taught I always had to go back and read for the test.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

   I liked both. I thought the group work was a nice break from straight lecturing. If you could I think it would be beneficial to do the group work but then cover the same material in your lectures as well because I think it helps cement it into our brains.

5. Do you have any additional comments you'd like to add?

   The only complaint I have is it was hard to transition from one professor to the next due to all their teaching styles being so diverse. You on the other hand were a great lecturer. You will be greatly missed

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1. Did you enjoy working in groups on the concept maps? Why or why not? The concept maps were a nice change of pace. It allowed us to get up and move. the only part that was hard was I didn't feel we got a thorough enough review on the first test that we used them for and then had some questions that we did not study.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. I did not feel it helped me understand it better than you teaching it. You are a very good lecturer and make it interesting to learn. SOme of the groups do not take it as seriously as the others and we miss information that is important.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? When you elaborate on the slides and do not just read them. You present the info in a interesting manner and use experiences and stories to bring it into perspective. We have had an instructor this semester that just read the slides and it was very frustrating because it was not helpful, not to be too blunt, but we can read. You just use it as a guide and actually teach the material.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? straight lectures in this case. see above.

5. Do you have any additional comments you'd like to add?Thanks for being an enthusiastic and supportive instructor. It's apparent to see you love teaching.

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1. Did you enjoy working in groups on the concept maps? Why or why not? It was a nice break from lecture and gave a visual/hands on learning opportunity, however, I did feel that we missed the whole picture.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. Teaching each other did help me remember the content and learning in a small group was also nice. But, if the person teaching was not very knowledgeable or enthusiastic about the topic I felt like it was a waist of time.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? I remembered the content best when it was applied to a story or pictures.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? I like the mix between the lecture and group work.

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1. Did you enjoy working in groups on the concept maps? Why or why not? **Not really. There is a HUGE motivational factor involved for me personally. I lack the energy to really apply myself to the project. It also depends on the people you work with. Sometimes you can stimulate thoughts and ideas from one another. Other times it takes 20 minutes just to decide on who has the nicest hand writing.**

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. **I just have trouble in general getting focused. I have trouble shifting from lecture mindset to a group work mindset. In group work I just want it to be over with quickly so I skip on the detailed information and just give a basic outline. Unless someone else in the group is super motivated. I find that I do learn more about the topic I am presenting on, but when it comes to other groups I do not learn from other students very well at all. I am a visual learner and for some reason the pictures do not help me retain information.**

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? **Alison has a way of creating a mental picture with her lectures and connecting the processes of all of the aspects of nursing care together that makes sense. Other lecturers lacked this technique and I found that I did poorly on tests due to this. When I taught myself the material with these same lecturers I did better on the exams. The teacher can make all the difference. When I feel a lecture is inadequate for my learning (or I am on another planet during a lecture) I have to teach myself at home. In order to teach myself I have to be in a certain environment, at a certain time, and I have to mentally prepare myself ahead of time to know that I will be studying for several hours. I wish I was not so complicated and high maintenance!**

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? **Definitely straight lectures. I was able to write notes that correlated with the lecture that allowed me to, when studying on my own, recall the information better. Even when Alison would draw pictures of the heart on the chalkboard it was extremely helpful. But drawing my own pictures with group work was not. I guess it was because there was no detailed information provided WHILE the concept maps were taking place. Yes, I read the detailed info, but I retained it only for the time I needed to put it down on a piece of paper.**

5. Do you have any additional comments you'd like to add? **I know that I tend to go to class with the mindset of just wanting to be done. I think that this has a big impact on my ability to absorb information and process it. I get tired very quickly just sitting down for more than an hour. I have to say that I am grateful for your lectures, Alison, because I am pretty sure that this semester would have been a self taught semester without you. We are very appreciative!**

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1. Did you enjoy working in groups on the concept maps? Why or why not?

I did enjoy working in groups because it broke up the 4 hours of lecture. The group work we did in med/surg was better then the group work we have done in other classes. It can be hard to learn from other students because you can only get out what they put in.

2. Did you feel that working on the concept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning.

I feel that teaching the other students was the best way to understand the content. Making the concept maps was hard in a large group because only a few people could work at a time, maybe smaller groups would help. Allowing everyone to teach is a great idea. When we have done group work in the past the whole group would present the content and only one or two people would do the teaching. The down side is if you get someone in the group who doesn't care about learning the content themselves they are not go teachers. Overall I think teaching the concept maps was an effective teaching tool.

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams?

Actively taking notes and listening to clinical examples helped me retain information for the exams. I really enjoyed your style of teaching because you engage the class and actively teach us. Not everything you said was on your notes so I had to continually pay listen and take notes. I am not able to retain information when all the teacher does is read us slides. When we are given examples and extra explanation it makes coming to class worthwhile.

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why?

I prefer the lecture/group work because it gave us some different ways to learn the information. It is nice to have a break from lecture and learn/teach out peers. I did like that you

still went over the group work in a lecture format because we could pick up any information that may have been forgotten or not emphasized.

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1. Did you enjoy working in groups on the concept maps? Why or why not? **I do not particularly care for group work. Although I am more of a visual and hands on learner, I get more out of lecturing because it is repetative. I can hear it, see it, and then add notes to it.**

2. Did you feel that working on the comcept maps and then teaching each other the content helped you understand the material better? Please elaborate on what was helpful and what was not helpful about this experience in terms of learning. **I honestly think when it comes to group work some just do enough to get done because they know it doesn't work for them. I also feel that we may not put what the instructor feels is pertinant info on the poster and miss out of critical info.**

3. What aspects of either listening to lectures or participating in group work helped you to retain information for the exams? **I think that when a concept can be explained in different way during a lecture I retain the info better. We don't all learn the same.**

4. Did you prefer straight lectures (Cardiac and GI units) or group work (Respiratory and Neuro units) and why? **I prefered straight lectures rather than group work. I felt like the group work doesn't teach as in depth as we need and inforamtion that is tested on is often overlooked.** I remember the **Cardiac unit because it was reiterated in many different ways in lectures.**

6. Do you have any additional comments you'd like to add? **I think you are a great teacher in that you are able to explain concepts in all different ways for each and every learning style.**